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No. 228

ENERGY: STATUS AND DEVELOPMENTS --IV

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CONTENTS

NATIONAL DEVELOPMENTS

Energy Resource Policy to be Formulated
(GUANGMING RIBAO, 19 Jan 82)................................ 1

Opinions Offered on Academy of Sciences Energy Resource Research Directions
(GUANGMING RIBAO, 19 Jan 82)................................ 3

Conservation Seen as Basic Way to Solve Energy Problem
(Xu Shoubao; LIAOWANG, Oct 81).............................. 5

China's Energy Problems Are Many But New Approaches May Ease Near-Term Shortages
(LIAOWANG, Oct 81).. 10

HYDROPOWER, COAL, PETROLEUM, THERMOELECTRIC

Breakdown of Power Generating Capacities
(1981 ZHONGGUO JINGJI NIANJIAN, 1981)...................... 19

Site Selection for Hydropower Stations Emphasized
(Zhu Zongzhi; SHUILI FADIAN, 12 Aug 81)..................... 22

Ways to Improve Economy of Small Hydropower Stations Given
(Liang Zhaojia; SHUILI FADIAN, 12 Aug 81)................... 32

Gansu's First Large Thermal Power Plant Goes on Stream
(Wang Baolin, Si Ma; GANSU RIBAO, 5 Jan 82)................ 37

Big Capital Investments Reap More Electric Power in Gansu
(Zhi Jun, Jin Zheng; SHANXI RIBAO, 11 Jan 82).............. 39

Overview of Gansu's Small-Scale Hydropower Projects
(Wang Ruiting; SHUILI FADIAN, 12 Oct 81)................... 40

Hydropower Development Stepped Up as Gansu's Forests Shrink Alarmingly
(Qian Zhenyong; SHUILI SHUIDIAN JISHU, 20 Dec 81).......... 49

200-Kilowatt Mobile Power Station Makes Its Debut
(LIAONING RIBAO, 12 Jan 82)................................ 55

'JINGJI GUANLI' on Saving Energy in Coal Industry
(Mei Yan; JINGJI GUANLI, 15 Dec 81)........................ 56

Hanzhong Coal Mines Resume Operations After Floods
(SHAANXI RIBAO, 12 Dec 81)................................. 61

Increased Coal Production Reported in County in Hubei
(HUBEI RIBAO, 26 Nov 81)................................... 62

Daqing Oil Pipeline Overfulfills Quota
(Ding Hui; LIAONING RIBAO, 6 Jan 82)....................... 63

Shanxi Now Produces One-Fifth of Nation's Raw Coal
(SHANXI RIBAO, 15 Jan 82).................................. 64

Shigejie Registers Big Gains in Coal Extraction
(SHANXI RIBAO, 15 Jan 82).................................. 65

New Year Sees Greatly Increased Coal Output in Shanxi
(SHANXI RIBAO, 13 Jan 82).................................. 66

New Shandong Coal Pier Accelerates Exports
(Shandong Provincial Service, 17 Feb 82)................... 67

Shandong Meeting of Advanced Coal Production Units
(Shandong Provincial Service, 16 Feb 82)................... 68

Hard Work Pays Off in Exploiting Guangdong's Coal Reserves
(Tang Guangli; NANFANG RIBAO, 12 Dec 81)................... 69

Briefs

Mechanized Coal Extraction 73
Heilongjiang Power Plant 73
Shanghai Levies Surcharge for Excess Fuel Use 73

ALTERNATE ENERGY RESOURCES AND CONSERVATION

Fujian's Conservation Effort Showing Solid Results
(Xie Guohua; FUJIAN RIBAO, 4 Nov 81)...................... 74

Simple Solar Cookers Welcomed in Gansu's Rural Villages
(TAIYANGNENG, 1981)...................................... 76

New Studies Focus on Producing Methane from Industrial Wastes
(Guo Shiying; XIN NENG YUAN, 5 Dec 81)................... 80

Shandong Assesses Potential of Solar Energy, Methane
(Cai Zongjian; DAZHONG RIBAO, 5 Feb 82).................. 95

New Breakthroughs Give Added Promise to Solar Energy Development
(Li Mengming; XIN NENG YUAN, 5 Jan 82)................... 99

Shallow Solar Pools May Augment Conventional Energy Sources
(Ye Kewu; XIN NENG YUAN, 5 Dec 81)....................... 113

Nation's First Commercial Methane Venture Began in 1929
(XIN NENG YUAN, 5 Dec 81)................................ 116

Dwindling Resources, Environmental Deterioration Spurs Alternate Energy Development
(Zhang Qinghai; GUANGMING RIBAO, 20 Nov 81).............. 118

More Research on Wave Power to Produce Electricity Urged
(Pan Dahong; XIN NENG YUAN, 5 Jan 82).................... 120

Wind-Powered Waterwheels Save Energy
(Lin Yunxi, FUJIAN RIBAO, 4 Nov 81)...................... 122

Planting of Forests to Provide Energy Resources Urged
(Hou Yuanzhao; GUANGMING RIBAO, 25 Dec 81)............... 124

Fujian Focuses on Biogas Development Conservation
(Ou-yang Ying; FUJIAN RIBAO, 21 Oct 81).................. 127

Use of Bioenergy, Biogas in Yunnan Explored
(Jiang Yunhua; YUNNAN NONGYE KEJI, 25 Nov 81)............ 129

Sugarcane Touted as Excellent Bioenergy Resource
(Xu Kehua, Zhang Xinzheng; KEXUE YU WENHUA, 25 Mar 81).... 133

Fujian Pins Hopes on Renewable Energy Sources to Augment Coal, Hydropower
(Ye Qing; FUJIAN RIBAO, 29 Oct 81)....................... 134

Nei Monggol Commentary on Energy Conservation
(Nei Monggol Regional Service, 26 Mar 82).................. 136

Briefs

Liaoning Energy Conservation 137
Nei Monggol Energy Conservation 137
Biogas Exhibition 137

ENERGY RESOURCE POLICY TO BE FORMULATED

Beijing GUANGMING RIBAO in Chinese 19 Jan 82 p 1

[Article: "China's Energy Resource Policy Research Has Achieved Tremendous Results"]

[Text] Report by journalist Zhou Wenwu [0719 2429 2430]: The first draft of our nation's first comprehensive, systematic energy resource policy research report was recently completed. Representatives at the third All China Forum on Energy Resources and the annual session of the Chinese Energy Resources Research Committee which were held from the 5th to the 14th of January this year carried out discussions of this research report.

In the 32 years since the establishment of the nation, although we have compiled a tremendous record in the energy resource tasks of our nation, we have nonetheless lacked a fully systematic and comprehensive research effort, which in conjunction with the limitations imposed by departmental differences and numerous regulations, has always made it impossible for us to make an analysis in keeping with actual conditions of the short and long-term effects of a given policy, has led to numerous changes and errors in energy resource policies and has effected the rate of the development of the national economy.

As early as the first All China Forum on Energy Resources in 1979, experts suggested carrying out energy resource policy research in order to bring about a change in this situation. After the forum, experts at the State Science Commission carried out widespread survey research on problems involving energy resource prices, energy demand and projected production needs, conservation, rural and urban energy resources, energy resource transport, energy resource facilities, the energy economy, energy resource laws, etc. in order to prepare for the writing of the energy resource policy research report. At the end of 1980 the establishment of the Chinese Energy Resource Research Committee further promoted the research of energy resource policy. In February of the following year, the related departments of the State Science Commission, the State Accounting Commission and the State Energy Resources Commission, and the Chinese Energy Resource Research Committee jointly announced that the Chinese Energy Resources Research Committee would take responsibility for writing the Energy Resource Policy Research Report. In the last year, more than 500 experts, professors, technicians and management cadres from each of the related commissions, scientific research organizations and high level institutes, and over

100 provincial and municipal units, carried out every kind of specialized and comprehensive survey research, held more than 70 discussion sessions and began fullscale writing and editing work. Through concerted efforts on everyone's part, the working draft of this important report was completed on schedule.

At the Third National Forum on Energy Resources and the annual session of the Chinese Energy Resource Research Committee, experts offered a high level evaluation of the research report. First, its content is fairly comprehensive and complete--from the analysis and evaluation of the present energy resource situation to the development of energy resource transport, transfer and utilization and the projection of demand and production needs, from conventional energy sources to new and renewable energy sources, from urban and rural energy resources to the social, economic, legal and scientific and educational aspects of energy, everything was fully discussed. The report will supply data, methods and background material to enable our nation's leading energy resource and economic organs at every level to establish policies and programmes.

After the meetings, on the basis of opinions gathered from energy experts in all specialized areas and from management cadres, the Chinese Energy Resources Research Committee prepared to refine, summarize and enrich the material and compose a "Chinese Energy Resource Policy Programme."

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OPINIONS OFFERED ON ACADEMY OF SCIENCES ENERGY RESOURCE RESEARCH DIRECTIONS

Beijing CUANGMING RIBAO in Chinese 19 Jan 82 p 1

[Article: "The Academy of Sciences Must Strengthen Its Comprehensive Research on Energy Resource Technologies"]

[Text] Recently, the Energy Resource Research Committee of the Chinese Academy of Sciences invited some members of department committees to hold a forum to discuss a five-year plan and a tentative ten-year plan for energy resource research by the Academy. The following are notes on some of the ideas and suggestions made by the members of the department committees who participated.

Wu Zhonghua [0702 0112 5478]: In solving our nation's energy resource problems we must rely on policy, management and science. The establishment of correct policies and the carrying out of effective management must be based on science. I suggest that the Academy of Sciences develop the special features of numerous disciplines, concentrate part of our energies, stress comprehensive, strategic goals and emphasize basic research, while also researching highly practical items which promise quick results in order to help the national economy.

Hou Xianglin [0186 4382 7792]: The Academy of Sciences must fully develop the excellence of working comprehensively and putting great effort into basic research and must carry out more work of a pioneering nature, combining the long-range with the near at hand. For example, in geophysical research and long-range forecasting--it should supply scientific data to the geological prospecting departments in order to reduce the costs of finding promising oil fields.

Shi Shaoxi [0670 4801 3556]: The energy resource research of the Academy of Sciences should be based on the policies of the Academy, should be concentrated on areas of unique character and should grapple firmly with new spheres. We must bring together all scientific methods and open up more comprehensive research.

Gu Dezhen [6253 1795 2182]: The Academy of Sciences in its energy resource research work must establish a suitable division of labor with production departments and must pay attention to cooperative efforts. The energy resource research planning of the Academy should be integrated with the nation's energy resource research planning.

Pan Jiacheng [3382 1367 3821]: Energy resource problems not only involve all areas of natural science research, but are also intimately related to social sciences such as economics, and because of this, must be tackled by combining various disciplines. We must break down departmental jurisdictions, cut across professions and departments and carry out overall scientific surveys and research, making concerted efforts and solving the key problems in energy resource research.

Hou Xueyu [0186 1331 3558]: There are many rural energy resource problems. Along with the improvement in rural conditions and the rise in the living standards of the rural population has come daily increasing contradictions between energy supply and demand, and this requires our full attention. For example, the Academy of Sciences could engage in a little basic work on the establishment of fuel forests, the ecological laws of forest maintenance, experiments with rural biogas, etc.

Shi Changxu [1597 2490 4872]: In energy resource research work we must first carry out a survey of materials, formulate long-range plans, pay attention to applied and basic applied research, formulate a program of material research and get everyone organized.

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CONSERVATION SEEN AS BASIC WAY TO SOLVE ENERGY PROBLEM

Beijing LIAOWANG [OBSERVATION POST] in Chinese No 10, Oct 81 pp 12-13

[Article by Xu Shoubao [1776 1108 3134]: "Energy Conservation--A Strategic Countermeasure"]

[Text] The energy problem has become a major concern all over the world. It is also the most important problem in China's economic development. How this problem is solved will directly affect the rate of development of China's economy.

Energy Conservation Has Major Significance

There are only two ways to solve the energy problem. One is to develop resources and the other is to conserve energy. Relying on development of resources to solve the energy problem requires three conditions: The first is resources, the second is capital and the third is time. In China, these three conditions are difficult whether in the near term, in the intermediate term or even in the long term. Coal, oil and natural gas provide 96 percent of China's energy consumption at present, and only a little more than 3 percent comes from hydraulic energy. China's reserves of energy resources are rich when we consider the absolute amount, but per capita they amount to only one-fifth those of the United States and less than the world average. The development of energy and transportation requires a lot of capital. The investment to exploit 100 million tons of coal (including transportation) is about 20 billion to 30 billion yuan. During the period of economic readjustment, our nation cannot allocate too much capital to develop energy. Construction of energy resources requires a long time and if we begin building now, it will be ten years before the role of these projects can be brought into full play. Last minute preparations will not solve China's intermediate-term and near-term energy shortage.

Although conserving energy means getting "energy" from the energy resources that have already been extracted, practice proves that it costs less, produces quick results, and reduces pollution. It is one measure that produces multiple results. There is a tremendous potential for energy conservation in China. At present, the whole nation's consumption of energy is one to two times higher than foreign nations. Taking 1978 as an example, our nation's consumption per 10,000 U.S. dollars of gross national product was 27.5 tons of standard coal while the consumption was only about 12 tons in the United States and Britain and 7 tons in France, Japan and West Germany. The consumption was 10.8 tons in India. At present, our nation's energy consumption is also higher than that during the "first five-year economic plan" period by onefold. During the first five-year plan period, energy consumption per 10,000 yuan of national income was 8.5 tons but in recent years this has reached 19 tons. The energy consumption in different regions in our nation is also not balanced. Shanghai has the lowest while some regions have a consumption rate several times higher than Shanghai. If by the year 2000 our nation has a population of about 1.2 billion and the per capita average national income is 800 yuan, then to maintain the high energy consumption of the present time would require at least 2.6 billion tons of standard coal. If we launch general energy conservation work in a big way, we can reduce the energy consumption to India's 1978 level. Then only 910 million tons would be needed. Based on an energy consumption of over 600 million tons in 1980 in our nation, we would only need to add 300 million tons. Therefore, energy conservation is the fundamental way to solve our nation's energy problems. Especially in the near term and the intermediate term, energy conservation should be the fundamental national policy for building the four modernizations in our nation.

The Guiding Ideology of Energy Conservation

Scientifically defined, energy conservation is to reduce the consumption of energy while satisfying the same needs or achieving the same goals. The amount that has been reduced is the amount conserved. Therefore, energy conservation must have a prerequisite. This is to satisfy the same need or achieve the same goal. For example, a boiler produces 10 tons of steam an hour and consumes 10,000 tons of standard coal a year. Through technical improvement and by improving its rate of thermal efficiency, it consumes 7,000 tons (of standard coal) a year. This is a saving of 3,000 tons. Ordinarily, the energy conservation that everyone talks about refers to this type of direct conservation. This is specific energy conservation. It does not include all aspects of energy conservation.

We know that when people are engaged in production, when people work or in living, besides directly consuming energy, they must also consume and occupy other forms of materials. For example, a steel and iron mill produces iron. Besides consuming energy, it also needs to consume such raw materials as sintered minerals, lime and refractory materials, and the production of these materials needs to consume energy. During the course of producing iron, the various materials have to be transported, and transportation also consumes energy. Blast furances and such machinery and equipment also have to use up energy to produce iron. The course of using these machinery and equipment is also the course of energy consumption. This is a kind of energy consumption that cannot be directly seen by people. For example, in China today, every 10,000 yuan increase in net income requires an average consumption of about 44 tons of standard coal. If we reduce the cost, then every 10,000 yuan increase in net income means a saving of 44 tons of energy. This kind of indirect conservation is frequently being overlooked by people now. Some economic workers will think of only how to improve boilers and kilns with low thermal efficiency and emphasize direct energy conservation whenever they mention energy conservation. Their views are narrow. They do not see the broader meaning of indirect energy conservation whose potential is much greater than direct energy conservation. The ways to conserve energy are almost countless. According to our analysis and estimates, last year, the whole nation consumed over 600 million tons of energy. The potential for direct energy conservation constitutes one third, or more than 100 million tons and the potential for indirect energy conservation constitutes two thirds, or more than 200 million tons. It can thus be seen, we should advocate general energy conservation and use it as the guiding ideology in energy conservation.

Countermeasures for General Energy Conservation

1. Conserve energy by improving the efficiency of energy systems. According to our estimates, the efficiency of the nation's energy system was about 26.8 percent in 1978 while that of advanced nations was about 40 percent to 50 percent. If the efficiency of our nation's energy system can be improved by 0.5 percent a year, then each year we can conserve 10 million tons of standard coal.

2. Conserve energy through the rational use of consumables. Factory buildings, machinery, equipment, and raw materials are all energy consuming entities. The energy consumed by these energy consuming materials constitutes about 60 percent of the total consumption of energy throughout the nation. For example, our nation's rate of utilization of steel products is 65.8 percent. Each year, about 6 million tons of steel products are wasted, equivalent to wasting 15 million tons of energy. If we include the energy used in building the steel and iron mill with an annual output of 6 million tons, the total waste of energy would be 30 million tons. If the rate of utilization of steel products is increased to 80 percent, 2.5 million tons of steel products can be conserved, corresponding to a conservation of 12.5 million tons of energy. Again for example, the effective utilization rate of our nation's chemical fertilizers is only about 30 percent. If the utilization rate of chemical fertilizers is increased from 30 to 60 percent, over 20 million tons of chemical fertilizers can be conserved, a corresponding conservation of over 20 million tons of energy. The percentage of utilization of water for irrigation in our nation is less than 50 percent. The percentage of utilization of wood is only 35 percent. The utilization rate of glass is only 60 percent, and the utilization of monocrystalline silicon is only 20 percent. Because the rate of utilization is low, the quality is poor, the useful life is short, therefore the allowance for write-off of raw materials in our nation is high. The waste is serious and the potential for energy conservation is great.

3. Conserve energy by conserving the amount of work. Transportation is our nation's main service sector. Its consumption of energy constitutes about 7 percent of the national consumption. Because China's economic distribution and control of transportation is irrational, the allowance for write-off of materials is high, and waste of energy in some transportation services exist. If we can improve planning, improve disposition, rationalize control, conserve materials, and reduce the weight of materials, we can then eliminate a lot of unnecessary service and conserve energy. If the whole nation conserves 10 percent of unnecessary transportation service, the energy equivalent of 4 million tons of standard coal can be conserved.

4. Conserve energy by controlling birth, controlling population growth and changing life style. Now, the amount of energy in civilian commodities in our nation is over 50 million tons. If we include the energy resources of noncommercial commodities, the two add up to a total of 320 million tons. Each person consumes an average of more than 0.3 ton of energy per year. The level of energy consumption is relatively low. Since the founding of the nation, China's population growth rate reached a high of 2.9 percent and then dropped to 1.4 percent in 1978. Compared to the highest growth rate, over 14 million fewer people are added each year, correspondingly conserving over 4 million tons of energy. If we consider indirect energy consumption, a total of over 12 million tons is conserved each year. It can be seen that reducing the population growth rate and conserving materials for living can all save a large amount of energy.

5. Conserving energy by rationally utilizing required capital. Any enterprise that engages in production and service must utilize fixed assets and circulating capital. This is actually utilizing various materials. The more capital an enterprise uses, the more materials it uses, the more materials the state has to produce, and thus more energy will be consumed. At present, our nation consumes an average of 10 tons of standard coal to produce 10,000 yuan worth of materials. If additional materials worth 100 million yuan in capital are used, 100,000 tons more of standard coal will have to be consumed. According to our estimates, in 1978 the nation's state-run industrial enterprises used over 26 billion yuan more in capital than the highest level in history. Correspondingly, over 26 million more tons of energy were consumed.

6. Conserving energy by conserving "other energy consumption." We call the consumption of energy brought about by various other causes such as national defense and military spending and land development, "other energy consumption." Since the founding of the nation, various construction needs have taken 180 million mu of farmland. When this developed farmland is used for urban construction or construction of factories, energy is consumed. Take lighting as an example. One mu of city land is lit by one 100-watt light bulb for 8 hours every night. In one year, it will consume over 300 kilowatt-hours of electricity. If the whole nation reduces the amount of land occupied by cities, a lot of energy can be conserved.

7. Conserve energy by increasing the output of various products and services. Energy consumption by products and services drops as the output of production and services increase. Take the Liberation automobile as an example, full loads can save 40 percent of the fuel used to transport half empty loads. Our nation has over 1.5 million automobiles. The percentage of full loads of trucks of local transportation departments is 66.7 percent while the percentage of full loads of automobiles of the various enterprise units in society is only 40 percent. Each year, about 1.2 million tons of gasoline are wasted. Therefore, the potential for conserving energy in output of unit equipment and services is also very great.

8. Conserve energy by improving the quality of various products and services. Poor quality products even to a point of being a waste product waste energy.

For example, the percentage of finished products of plate glass and steel products throughout the nation is only 74 percent. The percentage of finished products of cast iron works is 89 percent. The percentage of damage of plate glass during shipment reaches 8 percent to 12 percent. The loss of packaged cement in shipment is 5 percent to 10 percent. In addition, the percentage of superior quality goods is low. The percentage of first grade products of the nation's large and medium sized glass factories averages 73 percent while the highest level in history is 90 percent. It can thus be seen that if the 400,000 enterprises throughout the nation all reduce the percentage of waste products, reduce the percentage of damage, increase the percentage of finished products, increase the percentage of quality products, increase the percentage of superior quality products, a large amount of energy can be saved.

9. Conserve energy by reducing production cost. According to our estimates, if the average production cost throughout the nation reaches the best level in history, an additional net income of 24 billion yuan can be realized. This can conserve 100 million tons of standard coal. Therefore, this must be given great emphasis. We cannot invest precious energy into enterprises that have a high cost and small income.

10. Conserve energy by rationally arranging the economic structure, the direction of products, and the direction of services. From the viewpoint of energy consumption, energy consumption per unit of production value of heavy industry, energy consumption per unit of net income and energy consumption per unit of national income are all higher than those of light industry and agriculture. Take the energy consumption per unit of national income as an example, the ratio of energy consumption of heavy industry, light industry and agriculture is generally 13:4:1. It can be seen that to realize the same amount of national income, heavy industry requires an investment of energy that is two times the amount of investment in light industry, and 12 times the amount of investment in agriculture. Therefore, rationally adjusting the ratio among agriculture, light industry and heavy industry is very important to energy conservation. According to our calculations, if the ratio among our nation's agriculture, light industry and heavy industry can be adjusted to the level of 1966, each year, 83 million tons of energy can be conserved. Energy consumption by commerce, construction and services is about the same as the energy consumption of light industry. Therefore, developing commerce, construction and services can also conserve a large amount of energy. At present, conserving energy by adjusting the economic structure is a problem that is emphasized a lot by the nations of the world. According to forecasts, from 1975 to the year 2020, 48 percent of energy consumption of the whole world will be conserved. Of this, 17 percent will be realized by relying upon changes in economic structure.

In summary, to hasten the progress of the four modernizations, all professions in the nation should conserve energy and all can conserve energy. Therefore, everyone is responsible for energy conservation. According to our understanding, in 1978, our nation's energy consumption per 10,000 U.S. dollars of national income was 150 percent higher than that in India. If we can reduce our energy consumption to India's present level, 310 million tons of energy can be conserved a year. This target can be reached, the methods is: the whole nation must conserve energy.

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CHINA'S ENERGY PROBLEMS ARE MANY BUT NEW APPROACHES MAY EASE NEAR-TERM SHORTAGES

Beijing LIAOWANG [OBSERVATION POST] in Chinese No 10, Oct 81 pp 9-11

[Article by staff reporter: "Overview of Our Nation's Energy Resources"]

[Text] People's clothes, food, dwellings, travel, and the prosperity of the national economy all rely on energy resources. Therefore, the problem of energy has come about and has become an overall strategic problem in our nation's economic development. We shall introduce to the readers some information relating to this problem:

Energy and the Development of Energy Resources

Energy resources can be classified into two main categories. One category is renewable energy resources, such as plant energy resources, solar energy, hydraulic energy. The other category is non-renewable energy resources, such as coal, petroleum, natural gas. The energy problems the world is concerned about today refer mainly to the shortage in the supply of the latter form of energy resources.

The use of coal as an energy resource in China can be traced back to 2,000 to 3,000 years ago. During the Yuan dynasty over 700 years ago, Italian traveler Marco Polo wrote: The Chinese use stone for warmth and cooking, which he found curious. Thus it can be seen that at that time Europe did not know about coal yet. Only until about 1940, coal changed from being a simple fuel and joined the ranks of important raw materials. For example, steel and iron and the chemical industry. At present, although the estimated world coal reserve is 10,000 billion tons, only about 700 billion tons are workable. Calculating at an annual production rate of 3.4 billion tons, this can only last for a little over 200 years. Can we afford not to make early preparations?

Petroleum and natural gas are also energy resources that were first used by our nation. As early as the Ming dynasty, our nation had already sunk wells a thousand meters deep. In modern times, the United States and Romania first industrialized the exploitation of petroleum. It promoted the development of automobiles, aviation, chemistry and light and textile industries and became an industry with the largest profit. At present, the wave of replacing coal with petroleum has engulfed the world. Petroleum has become a commodity that can influence the world's economic situation. But the reserves of petroleum are not optimistic. They are much less than coal. Known exploitable reserves throughout the world amount to only 87.9 billion tons. Today, 3 billion tons are exploited each year. The United States consumes 900 million tons a year. The consumption by developing nations is also continually rising. It is not without reason that people are worried about the future of petroleum. The exploitable reserves of natural gas is over 70,000 billion cubic meters, and similarly, this cannot last for many years.

To delay the arrival of the energy crisis, atomic power plants are being built in many nations. Up to 1980, the world had more than 200 nuclear power stations with a total capacity of over 120 billion kilowatts. Many nations have huge development plans. But the technology of nuclear power plants is complex, and a longer time is required to produce results.

Hydraulic power for electric power generation is a regenerative energy resource. According to surveys of known exploitable hydraulic resources, China ranks first, followed by the Soviet Union, Brazil, the United States, Canada, and Zaire. Estimates by land area show that exploitable hydraulic energy resources throughout the world can generate an average of 72,600 kilowatt-hours per square kilometer throughout the world. The output of hydraulic energy resources in China can reach 200,000 kilowatt-hours, much higher than the world average.

Ocean energy has attracted widespread attention. Many nations are conducting small scale tests in the use of tides to generate electricity and are gradually forming an industrial sector. At present, the largest tidal power station in the world is France's Rance [River] Power Station. It generates 544 million kilowatt-hours of electricity a year. Electric power generation using temperature differences in sea water has passed the experimental stage. The United States has realized greater progress.

Many nations are utilizing solar energy to create heat for bathing and for cooking. After the solar cell was invented, it has been used in artificial satellites, residential lighting, and power for small aircraft and motorized vehicles. Small solar energy power stations have already begun operation and large power stations are being designed. Solar energy used to heat greenhouses and combined with surplus industrial heat has provided people with more fresh vegetables and foods. This can increase the per mu gain by 10 to 20 times in regions where the period of frost is relatively long, and it has received popular attention.

About bioenergy, people are most familiar with methane. Many nations are building large methane pits while treating waste water in cities. It has been reported that the largest pit is 12,000 cubic meters. At present, Canada has already increased the yield of gas per cubic meter of pits by 5 to 10 times. This achievement has attracted a lot of interest in methane as a source of energy. A methane pit of 10,000 cubic meters can produce 15,000 to 30,000 cubic meters of methane in 24 hours, equivalent to the amount of heat produced by a small coal pit with a daily output of over 10 tons of coal. Methane may become one of the pillars of man's future energy sources.

Wind energy is cheap power which has already been used for small scale generation of electric power and for drawing water. Large oil tankers also use the forces of wind to reduce power consumption.

Present Situation of Energy Resources in Our Nation

What is the situation of our nation's energy resources? Is our nation considered a major nation with rich energy resources? Some believe our nation's energy resources are rich, the future is bright, and our nation is one of the world's major energy resource nations. Some believe our nation's energy resources are not plentiful, the quality is not high, and in particular, per capita share of such resources is very small. They believe our nation is a nation with relatively deficient energy resources, and at most, our nation is a nation with medium energy resources.

Actual analysis of our nation's energy resources from the viewpoint of present technological and economic levels indicates that our nation's energy resources having practical significance are still "regular energy resources" of coal, petroleum, natural gas and water.

Coal: According to estimates made by the 10th World Energy Conference held in 1977, the total reserve of coal in our nation is 5,070 billion tons, ranking second in the world. Of the total reserve, the forecast reserve is 1,400 billion tons, ranking third in the world. But these two types of reserves cannot serve as the actual basis for planning. The reserves which can serve as the basis for planning are the known reserves, and in particular, the investigated reserves for mine construction. The degree of prospecting of coal resources in our nation is low. The cumulative known reserves amount to over 610 billion tons. The investigated workable reserves amount to 170 billion tons (of this, only 70 billion tons which are unworked are left). The degree of development and utilization of coal resources in our nation is low. There is a great waste of resources. There are 30 billion tons that cannot be developed and utilized in the near or intermediate future. There are only 40 billion recoverable tons which can be realized in the near future. When drawing up long-range plans, we feel that the resources are scarce. The above shows that the rough estimate of our nation's coal resources is large but detailed estimates indicate that the resources are not plentiful.

Petroleum and natural gas: Viewing the geological conditions, our nation's geological reserve of petroleum that can be found amount to over 60 billion tons. But our nation's sedimentary rock is mainly continental facies. This type of petroleum containing basins has three characteristics: The basins are small. There are many faults. The variation in lithological character of the oil bearing rock strata is large, and the reserves are buried deeply. The geological conditions of inland oil fields with good prospects in western China are even more complex. There are more mountains and the deserts are large, and communications is not convenient. The age of formation of our nation's marine deposits is older and these deposits are easily destroyed. These have all increased the difficulty of prospecting. In particular, our nation's prospecting strength is weak and the degree of prospecting is very low, therefore, the cumulative known reserves on hand amount to only 6.8 billion tons to 7 billion tons. Of this, workable reserves constitute 2.3 billion tons, and 700 million tons have already been exploited with over 1.6 billion tons remaining, ranking 11th in the world. The cumulative known reserves of natural gas amount to over 230 billion cubic meters, the remaining exploitable reserves amount to 178.4 billion cubic meters, ranking 23rd in the world. Now, our nation produces 100 million tons of crude oil a year. The ratio of reserve to extraction has dropped from 80 to 1 in 1965 to 15 to 1, and there is a decreasing trend. Under normal conditions, the ratio of reserve to extraction of petroleum should be 30 to 1, and this cannot be lower than 20 to 1 so that the oil fields should at least be able to last for 20 years. The ratio of reserve to extraction of petroleum in our nation at present is seriously imbalanced, and the situation of natural gas is the same. In general, the future of our nation's petroleum and natural gas resources are bright. At present, there is a serious shortage of reserve resources. There is a lack of prospecting and technical strength. The means of prospecting are backward. The speed of enlarging the known reserves is slow. Concluding that our nation's oil and natural gas resources are rich or not now is still too early.

Our nation's hydraulic resources are unique. The theoretical reserve is 680 million kilowatts. The annual output is 5,900 billion kilowatt-hours. Of this, the exploitable amount is 370 million kilowatts and 1,900 billion kilowatt-hours, constituting 25 percent of the world's total, ranking first.

What is the general concept of our nation's reserve of energy resources? Experts convert coal, petroleum, natural gas and water to standard coal and add them together. The long range reserve is over 3,900 billion tons. The cumulative known reserve is over 430 billion tons, per capita average is over 450 tons.

Advantages and Shortcomings of Our Nation's Energy Resources

The quality of our nation's energy resources has advantages and shortcomings. According to expert analyses, the shortcomings are as follows: Among our nation's mineral energy resources, the proportion of petroleum and natural gas which produces a high amount of thermal energy and which is convenient to use is very small while the proportion of coal is especially large. Among the known reserves, petroleum and natural gas constitute 4 percent and coal constitutes 96 percent. The advantage is as follows: There is a lot of hydraulic resources. Although petroleum and natural gas resources have many advantages, they are nonrenewable. There will be less after they are extracted, and they seriously pollute the environment. Hydraulic resources are the cleanest energy, and they are renewable. Theoretically speaking, their reserves are infinite and they can be continually utilized.

Regional distribution of energy resources is not balanced. Over 85 percent of the known reserves of coal are concentrated north of Qinling and Huai River, and over 60 percent are found in northern China while only 1.8 percent is found in the nine provinces and cities south of the Changjiang. Petroleum is mainly concentrated in the northeast, constituting 51 percent, while 5 percent are found in the south central region and almost none is found in the southwest. The five provinces and autonomous regions of Heilongjiang, Hebei, Shandong, Xinjiang and Liaoning possess 81 percent of the total national reserve. Natural gas is mainly concentrated in Sichuan, Guizhou, Liaoning, Hebei, Shandong, and Qinghai. Sichuan (including a part of Guizhou) has 68 percent of the national total. Based on the exploitable amount of hydraulic resources, the southwest possesses 71 percent and northern China has extremely small amounts.

Comprehensively speaking, coal, water and natural gas resources are medium in abundance while there is plenty of petroleum. Northern China has little water but coal is extremely plentiful and there is also a lot of petroleum. The northwest has a lot of coal, water, petroleum and natural gas and the future of coal and petroleum is very good. The southwest has less petroleum but plenty of water and natural gas. The energy resources of these four regions are all assured. Only the south central and eastern China regions have less of all types of energy resources (the south central has relatively plentiful water) but the population is large and energy resources are lacking.

Statistics of known reserves show that the degree of assurance of energy resources in each of the large regions can be divided into the following these groups: Northern China has the most with a per capita average of more than 2,500 tons of standard coal. The southwest, the northeast and the northwest have over 300 tons, over 400 tons and over 600 tons respectively. The south central and especially eastern China have the least, over 100 tons and over 60 tons respectively. Because the reserve resources of our nation's energy industry is insufficient (except hydraulic resources), it is difficult to increase the production of coal, petroleum and natural gas in the near future and the production of some is even decreasing, causing a nationwide energy shortage. The conflict between production and need in the regions of our energy industries is great: Not only must northern coal be shipped to the south, northern electric power (thermal power) will also have to be shipped to the south. Western coal has to be shipped to the east, western electric power (hydraulic power) has to be sent to the east, northern oil (crude oil, finished oil products) has to be shipped to the south, and eastern oil (finished oil products) has to be shipped to the west. This has greatly increased transportation cost and the investment in the transportation of energy resources.

Shortage of Energy and Shocking Waste

Our nation's industrial facilities and technologies are backward. Business management is poor. The structure of productive industries is irrational. The consumption of energy per unit of productive value is much higher than major industrial nations. Converted to U.S. dollars, the energy consumption per 10,000 yuan of productive value in our nation is 27.5 tons of standard coal, much higher than the 5.35 tons in West Germany. Shortage of energy throughout the nation is common. In 1978, the nation had an average shortage of 10 million tons of coal, 10 million tons of oil and 30 to 40 billion kilowatt-hours of electric power. Industrial enterprises have not operated on a full scale because of insufficient energy, losing over 75 billion yuan in productive value a year. The shortage of energy for agricultural use and the shortage of fuel for civilian use are even greater. Among the residents of the nation's cities and towns, 30 percent basically do not have coal to burn. Most of the farm families in farm villages burn stalks. Each year, they burn over 600 million tons of stalks, but the annual production is only 450 million tons. Deducting necessary feed and raw materials for processing, there are only over 200 million tons for civilian fuel, less than half the amount needed. There are over

70 million families throughout the nation that seriously lack fuel to burn. There is also a serious shortage of energy needed for agricultural production. The amount of horsepower of presently available agricultural machinery throughout the nation is 160 million horsepower. The state can only provide 8 million tons of diesel fuel a year, an average of over 50 kilograms of fuel per horsepower, enough only to operate for over 50 days. The south central lacks over 18 million tons of standard coal a year. Eastern China lacks 13 million tons. The nine provinces and cities south of Changjiang together lack over 75 million tons. Energy shortage not only has affected present production and life, it has also become a "bottleneck" in our nation's future national economic development.

Some comrades have roughly calculated that if we increase our nation's rate of energy utilization from 28 percent to over 50 percent, we can conserve over 300 million tons. Its direct economic benefit is at least 12 billion yuan to 15 billion yuan. If the energy thus saved is used to expand reproduction, the economic results will be enormous. Calculating at a consumption of 5 tons of coal per 10,000 yuan of productive value, we can obtain 600 billion yuan in productive value. At a tax revenue of 15 percent, this will provide an income of 80 billion yuan for the state. This shows that the potential of energy conservation is great, and only by grasping this link can technological reform and the reform of the industrial structure in the national economy follow a smooth path.

Thirteen Energy Policies

Some time ago, the Chinese Energy Research Society proposed thirteen ways to ease our nation's energy shortage. Their main points are as follows:

1. Grasp the opportunity of readjustment tightly and carry out the first phase of building energy resources well.

Experts believe that in the development of energy, the guiding ideology of "emphasizing production and neglecting prospecting" must be corrected. The investment required for the work of the first phase is not much and the work of the first phase is an important element of internal adjustment of energy production and its significance is great. Under the present situation in which investment during the initial period of readjustment is less, it is a good opportunity to improve and strengthen this work and it should be grasped tightly and carried out.

2. Energy in farm villages affects the stability of 800 million farmers.

Experts say the social stability of our nation's 800 million farmers is the foundation of national stability. At present, farmers are forced to gather and use all combustible material for daily needs. This is not only a waste of a lot of labor, it also creates wide-spread destruction of the ecology. Since liberation, the area of soil erosion in our nation has expanded from 1,100,000 square kilometers to 1,500,000 square kilometers. The area of deserts has expanded from 1.6 billion mu to 1.9 billion mu. The percentage of forest covering is less than 12 percent. The content of organic substances in the soil has dropped to a dangerous level. The area of cultivated land affected by natural disasters each year throughout the nation covers about 600 million mu. All of these are related to the serious shortage of energy for living in the farm villages.

Experts emphasize that building up energy in farm villages should be included in national plans. Various major measures should be taken to change the serious shortage of energy for living in farm villages, and nationwide worsening of the ecology should be gradually stopped. This is a strategic policy to protect natural resources and the environment so that our natural resources and the environment so that our nation's agricultural production will change to a benevolent cycle. The state should provide the greatest possible support for energy consumption in farm villages.

3. Hydroelectric power should be developed as a priority and a general company for the development of hydraulic energy should be established.

Developing hydroelectricity as a priority is a successful experience in the history of energy development in the world. Our nation's hydraulic resources rank first in the world, but now, the amount of hydroelectricity constitutes only 3 percent of the exploitable amount. This undoubtedly is a strategic mistake.

Experts suggest that a "China Hydraulic Energy Development Company" should be established under the National Energy Commission. The state should provide strategic investment to the company during these few years. Later, it will rely on its own resources "to nurture water with water" and develop rapidly. At present, there are still mainly medium sized hydraulic resources with a capacity of 60 million to 70 million kilowatts in eastern China, the south central region, southern China and the northeast where the population is dense and where the electric power load is concentrated. These should be the key points of development during the next 20 years.

4. Production, supply and marketing should be unified and matched to revive the role of coal.

Experts suggest that the production, supply and marketing (including export) of coal should be unified to revive the role of coal so that production and marketing will be matched and the supply will be timely. The reason is that in the present uniform rationing of coal, there are 240 million tons of unprocessed coal being shipped to users each year. The amount of waste rock being shipped out reaches 36 million tons, occupying over 20,000 railway cars-times and the wasted expense in transportation cost is 150 million yuan. When production and marketing are matched, the coal mines can be encouraged to actively develop washing and processing of coal and to produce superior quality and good priced coal. This alone will enable the coal mines to increase annual profits by over 500 million yuan. The whole nation can conserve over 10 million tons of coal and can reduce the burden of railroad transportation.

5. Construction of the Shanxi coal base should be grasped tightly.

Experts believe the development of Shanxi coal is the most important decision that will enable our nation's economy to realize visible increases. The building of the Shanxi energy base involves a broad scope. The difficulty is great, and it can be smoothly carried out only under unified command and planning by the Central authority.

6. Join together, grasp the second general survey of petroleum tightly, increase reserves and seek production.

The future of our nation's petroleum and natural gas resources is good. At present, expanding the known reserves is the key to continued development of the petroleum industry. Experts suggest that all the departments should be organized starting from right now to draw up scientific plans, to launch a second general survey of petroleum throughout the nation, to establish the foundation for discovering new large oil and gas fields, and to strive towards "increasing reserves and seeking production" in the near future and "increasing reserves and increasing production" in the long term.

7. Carry out general surveys of energy conservation, planning and management work concretely.

Our nation's potential for energy conservation is great. In the near future, conserving energy and seeking to increase production are obviously the only reliable means. Experts suggest that within one or two years, forces should be rapidly organized to conduct comprehensive and systematic surveys, to study and analyze the direction of energy conservation, the potential, the economic results, the relationship between energy conservation in each sector and the national energy balance, the feasibility of reforming the industrial structure and product structure and its limitations, economic policy for energy conservation, rational distribution of investment for energy conservation and energy production, and to draw up reliable plans and laws for energy conservation. The present energy conservation measures are: to strengthen management, to train personnel, to replace out-dated energy consuming facilities. Investment in energy conservation must be subjected to technical and economic comparison and feasibility analysis for every project. Each project must be strictly screened to assure practical results.

8. Grasp the beginning tightly and develop nuclear energy.

It is suggested that a nuclear energy bureau be established under the National Energy Commission to carry out uniform planning and draw up plans for division of labor and cooperation for steady development.

9. Actively develop new energy and travel our own road.

New energy refers to new applications of solar energy, bioenergy, wind energy, small hydroelectricity, tidal energy, ocean energy, geothermal energy. The potential of new energy in our nation is great. If we emphasize actual results in developing new energy, it is possible that it will become an important way to solve the energy problems in farm villages. Experts suggest that the state provide capital assistance to popularize new energy and to include it in state plans.

10. Develop urban gas, improve the supply and utilization of civilian coal.

11. Hasten research in coal gasification and liquefaction.

12. Strengthen comprehensive study of prices to create conditions for rationalization of energy prices.

13. Include in the daily agenda the establishment of a modern scientific and technological system for planned management.

Energy shortage is a mjor worldwide problem. Viewing our nation's energy problem from all sides, the conclusion is: grasp the development of energy tightly, stop wastefulness!

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HYDROPOWER, COAL, PETROLEUM, THERMOELECTRIC

BREAKDOWN OF POWER GENERATING CAPACITIES

Beijing 1981 ZHONGGUO JINGJI NIANJIAN [1981 ALMANAC OF CHINA'S ECONOMY] in Chinese p 252

[Excerpts] According to type, China's power stations are broken down into hydropower stations, coal-fired stations, oil-fired stations, and (natural) gas-fired stations:

Power Generation Resources by Type	Installed Capacity (10,000 KW)	Percentage of Total Capacity
Hydropower	1,911	30.3
Coal-fired	3,296	52.3
Oil-fired	1,076	17.1
Gas-fired	19	0.3
Total	6,302	100

Administratively, China's electric power stations are divided into two categories, public-use and self-provided:

Item	Installed Capacity (10,000 KW)	Percentage of Total Installed Capacity
Public-use Power Plants	5,673	90.0
Self-provided Plants for Industrial Enterprises	357	5.7
Agricultural Commune Plants	272	4.3
Total	6,302	100.0

Region	Installed Capacity (10,000 KW)	Names of Major Power Stations
NORTHEAST REGION		
Liaoning Province	498.8	Qinghe, Fuxin, Liaoning, Chaoyang, Shuifeng
Jilin Province	223.07	Jilin Thermal Plant, Changshan, Hunjiang, Fengman
Heilongjiang Province	241.38	Haerbin Thermal Plant, Jiamusi, Xinhua
Subtotal	963.25	
NORTHERN REGION		
Beijing City	190.5	Gaojing, Shijingshan, Beijing 1 and 2 Thermal Plants
Tianjin City	146.93	Dagang, Tianjin 1, 2, and 3 Power Plants
Hebei Province	320.72	Douhe, Tangshan, Matou, Fengfeng
Shanxi Province	238.11	Shentou, Niangziguan, Tiayuan 1 and 2 Thermal Plants
Nei Monggol	121.4	Baotou 1, 2 and 3 Thermal Plants, Wanjiazhai Hydropower Station
Subtotal	1,017.91	
EASTERN REGION		
Shanghai City	311.43	Wangting, Minhang, Zhabei, Jinshan, Wujing
Jiangsu Province	286.31	Jianbi, Xuzhou, Nanjing, Tianshenggang
Zhejiang Province	250.67	Hangzhou, Yiwu, Xinanjiang, Fuchunjiang
Anhui Province	175.42	Huainan, Huaibei, Ma'anshan
Fujian Provincw	149.72	Yungan, Gutianqi
Jiangxi Province	151.85	Nanchang Power Plant, Fenyi Power Plant
Shandong Province	321.83	Laiwu, Jining, Xindian, Shilichuan, Zhanhua
Subtotal	1,647.23	

SOUTH-CENTRAL REGION		
Henan Province	323.2	Yaomeng, Jiaozuo, Kaifeng, Loyang, Sanmenxia
Hubei Province	346.13	Qingshan, Huangshi, Danjiangkou
Hunan Province	287.1	Fengtan, Zheqi, Dongjiang, Jinzhushan, Changsha
Guangxi Autonomous Region	172.38	Heshan Power Plant, Nanning, Xijin, Zhaoping, Lodong
Guangdong Province	275.74	Xinfengjiang, Maoming, Huangpu, Fengshuba
Subtotal	1,404.55	
NORTHWEST REGION		
Sha'anxi Province	167.8	Xi'an 1, 2, and 3 Power Plants, Hancheng, Qinling, Tongchuan
Gansu Province	286.38	Lanzhou Power Plant, Xigu Thermal Power Plant, Liujiaxia, Yanguoxia
Qinghai Province	16.32	Xining, Qiaotou, Chaidamu [Qaidam]
Ningxia Autonomous Region	47.42	Qingtongxia, Yinchuan, Zhongning
Xinjiang Uygur Autonomous Region	69	Urumqi, Yili
Subtotal	586.92	
SOUTHWEST REGION		
Sichuan Province	373.36	Gongju, Congqing, Douba, Chengdu, Luzhou
Guizhou Province	143.29	Qingzhen, Guiyang, Shuicheng, Wujiangdu
Yunnan Province	154.13	Kunming, Kaiyuan
Xizang Autonomous Region	5.85	Lhasa
Subtotal	676.63	
Trains	5.1	
National Total	6,301.59	

CSO: 4013/27

HYDROPOWER, COAL, PETROLEUM, THERMOELECTRIC

SITE SELECTION FOR HYDROPOWER STATIONS EMPHASIZED

Beijing SHUILI FADIAN [WATER POWER] in Chinese No 8, 12 Aug 81 pp 29-32, 43

[Article by Zhu Zongzhi [2612 0022 0037] of the South Central Surveying and Design Academy of the Ministry of Electric Power: "Several Experiences in Site Selection for Hydroelectric Power Stations on the South-Central Area"]

[Text] Prior to 1965, our academy carried out planning for 23 river valleys and 22 regions, covering the five provinces of Hunan, Hubei, Jiangxi, Guangxi and Guangdong, and correctly selected a group of hydroelectric construction projects (such as Shangyoujiang, Zhexi, Bailianhe, and Dongjiang) to be started, and prepared a number of backup projects, satisfying the nation's "25" construction needs. At the same time, we trained cadres and gained experience. During the 10 years of upheaval, planning and site selection work basically halted, thus causing the present situation of "finishing the old tasks but not being able to catch up with the new." To turn this passive situation around and to open up new hydroelectric energy sources to realize the four modernizations, planning and site selection work for hydroelectric power stations has again been included on the agenda of important business. Therefore, it is necessary to summarize past work and absorb experience and lessons so that the future work of planning and site selection will be more tailored to the needs of the four modernization. The experience in our work can be summarized mainly in the following points:

I. We must establish a firm strategic ideology in order to carry out the initial work of planning and site selection in the first phases of hydroelectric power construction.

The Central Committee pointed out back in 1954 that hydroelectric power construction must actively start from river valley planning. Planning and site selection are tasks to establish the "foundation" of hydroelectric construction. They are the starting points to achieve greater, faster, better and more economical results in the entire engineering construction task. If planning and site selection have been carried out well, the entire hydroelectric battlefront will "win at the beginning," establishing a firm foundation for later "immediate success." Otherwise, even if later surveying and design are done well, it will be attending to details to the neglect of essentials.

Hunan's Zhexi Hydroelectric Engineering Project is a relatively successful project. The concepts in the plan are almost all being realized according to schedule. For example, the dam site selected during planning was in general not changed later. The initial estimate of the total amount of concrete was 820,000 cubic meters, and the actual amount was 860,000 cubic meters. The initial estimate of the total installed capacity was 390,000 kilowatts, and the final installed capacity was 450,000 kilowatts. Initially, it was estimated that the project would start production at the end of 1961, and it actually began generation in January 1962. Therefore, the program for site selection for Zhexi was believed to be correct at the time, and now practice has proven that it was relatively comprehensive and relatively correct. One of the main reasons the Zhexi Hydroelectric Power Station project was successful was that planning and site selection were carried out correctly.

The planning for hydroelectric power for water conservancy on Hainan Island from 1964 to 1965 clearly took into account the overall water conservancy power resources of the whole island, and a group of relatively good engineering projects were selected as backup projects for the entire island in accordance with natural, social, and economic conditions. At the same time, such engineering projects as Guangba and Niululing that had a greater gain, that had good topographic and geological conditions, that had superior economic indexes, and that suited the needs of development of the national economy of Hainan Island at the time were developed first, and they have served well in a reference capacity.

Planning and site selection affect the people's lives and the development of the national economy of the locality greatly; in particular, they are significantly and directly related to the submerged region of the reservoir and the region benefiting from the project. In the site selection stage, the areas that will be submerged that will benefit and the time must all be correctly determined basically so that the production and life of the people in the region of the reservoir can be rearranged early and the corresponding capital construction of the region to be benefited can be carried out in time so as to achieve early and large gain.

During planning and site selection of the Baiyutan project, it was believed that "according to surveys, within the normal high water level, loss due to flooding will be very slight and can be ignored." In later design stages, loss due to flooding was not rechecked. Construction of the project started in 1958, the storage of water in 1960; because the original estimate did not include flooding, the masses in the region of the reservoir did not move out and carried on production as usual. As a result, in 1961, 12 million jin of food grains were lost and 4,400 houses collapsed, causing severe economic loss and damaging political effects. The reservoir actually flooded 42,500 mu of fields and forced 33,000 people to move.

Planning and site selection are direct preparatory tasks for engineering surveying and design. Part of the basic information gained during the planning and site selection stage can be directly utilized in later design. The other part can serve as important reference material, providing design work with topics and suggestions for engineering design. They are all important bases for design work.

The scope of planning and site selection is broad, there are many specialities, the policy and regional aspects are strong, and the questions involved are complex. We must be skillful in grasping the key points and the key among the complex issues; we must envisage the direction and the beginnings, and handle well the many complex and interwoven conflicts among need, economy and feasibility.

Strengthening planning and site selection work requires a specialized team. This is the fundamental requirement of carrying out planning and site selection well. At the same time, the work must be closely coordinated with concerned units in order to handle conflicts in a unified way.

II. The organic combination of need, economy and feasibility is the basic principal of planning and site selection.

Need, economy and feasibility are mutually contradictory and also mutually linked. Under the prerequisite of satisfying or basically satisfying the need, we must select as economical and rational a plan as possible, but the need is not absolute or unlimited. For example, in electric power, too much leeway should not be left for the future. In flood prevention, the standard should not be set too high. In irrigation, the area should not be too large. If one hopes to solve all problems with one or two projects, then one will easily divorce oneself from the current level of development of the national economy and the possibility of objective realization, and it will be impossible to carry out the actual project.

Economic comparison is an important tool to thoroughly implement the guidelines of thriftiness in building up the nation. We have already suffered from the neglect of economic comparison, so in planning and site selection, we must carry out economic comparison, do the work according to economic laws, select the best plan that costs the least but produces the greatest results, and make the optimum selection. But because of the limitations of the present scientific and technological levels, the methods of economic comparison also have definite limitations. The gains and losses in cost cannot accurately reflect the value.

When carrying out economic comparison, frequently a conflict between near-term gain and long-term gain occurs. Generally, the near term should be the main consideration, with appropriate care for the long-range benefits. This is because only after the near-term gain has been large and the national economy has developed rapidly can the long-term gain be realized. But we must not destroy the future utilization of important water energy resources in order to realize a near-term, smaller project.

Need and economy are two problems that are generally more obvious, while feasibility and realization of engineering construction are frequently difficult to see clearly. During the period of rapid national economic development, the scale of engineering projects is becoming larger and larger; in particular, in the selection of some large-scale projects, frequently the scale greatly surpasses the projects that have already been built in the nation, so the problem of feasibility in selecting large-scale projects must be carefully considered. Regarding feasibility, our guiding thought is that the thinking must be liberated, but we must be steady and reliable and we must be in an invincible position. The method is to carry out in-depth survey and research. We must survey the hydrology, geology, the amount of major construction, difficult construction, risky construction, construction schedule of a controlling nature, materials, facilities, technical conditions, the level and experience of projects already built, the level of development of new domestic and foreign technology, etc. Studying the feasibility on this basis possibly will be accurate. If the plan is completed without in-depth survey and research, problems can hardly be avoided.

The principle of organic combination of need, economy and feasibility is easily accepted by people in theory, but it is more difficult to grasp in practice; this is because our nation's water energy resources are rich and the needs of economic development are multifaceted. Our method of utilizing this principle in planning and site selection work is as follows:

1. We must have a clear understanding on an overall basis of the regional water conservancy and water energy resources. This cannot be done by relying on one or two units. We must have cooperation among related units. For example, "The Power Supply Plan for Central China" and the planning regarding the major rivers in Hunan Province compiled by our academy are products of cooperation.

2. We must rank the water energy resources of each region according to the classifications of region, scale, gain and economic index based on information already at hand. On the one hand, this can aid selection, and on the other hand, we can pick out some of the better choices as subjects for in-depth survey and research.

3. We must continue in-depth survey and research from the entire area to individual sites and from the general to the specific. In planning and site selection for large-scale engineering projects, in general, only one or two engineering projects can be started within a specified period. To select these one or two projects, we must reduce the number of water energy resources for engineering projects to be compared. To select one engineering project to "begin construction," we need two to four engineering project plans to compare. If there are too many plans, the workload is too great. If we determine the plan according to preliminary information, we may not decide correctly and we may not be sure about it; we may even commit grave mistakes.

The preliminary planning and site selection work for the Zhexi project by our academy were carried out according to the principle of combining the three aspects of need, economy and feasibility. At the time, Hunan wanted a large-scale hydroelectric power engineering project to solve the problem of power consumption for the industrial region in central Hunan and for electric power drainage and irrigation of the Dongtinghu region. It also asked for a project that would promote a relatively large agricultural gain. Comparing the several large-scale engineering projects with relatively good conditions throughout the province, the scale of the Wuqiangxi project on the Yuanshui River would be too large, the distance of transmission of power to Zaoshi city on the

Lishui river would be too great, and the main stream of the Xiangshui River would flood too large an area and there would be no good key water control project. The possibilities for such a project on the tributaries of the Dongjiang River would be good, but the river is situated in southern Hunan and it would be difficult to transmit power to the Dongtinghu region, and basically it would not produce any agricultural gain. Therefore, it was decided that the site selected for this engineering project should be in the Zishui River valley. We selected three engineering projects on the Zishui River for detailed comparison: Zhexi, Youxi and Shimoxi. The output power and capacity of the Zhexi power station could satisfy the needs of the power system for 5 to 10 years, the reservoir could basically eliminate damage to farmland from flooding over a 700,000-mu area at the end of the Zishui River, and the agricultural gain would be large. The economic indices of Zhexi were the best; the installed capacity would be 450,000 kilowatts. The initial total investment would be a little over 100 million yuan, basically suiting the present level of economic development in the nation. The geological conditions of the dam site were good; although the installed scale was large, the amount of concrete for the large dam totalled only a little over 800,000 cubic meters. Although construction would be intense, as long as the organization was good, it could be completed in time.

At the same time, there was another view holding that the amount of construction required for the Zhexi project would be large and that it could not be completed in time, and it was suggested that Youxi, on the upper reaches, be selected. The gain from power generation at Youxi would be only one-fourth or one-fifth that of Zhexi, the investment would be two-thirds that of Zhexi, basically there would be no gain in flood prevention, the geological conditions were poor, and the difficulty in construction would not be much less than that of Zhexi. There were others who advocated the larger scale Shimoxi for operation. The installed capacity of Shimoxi would be 650,000 kilowatts; although the gain in flood prevention would be greater than that of Zhexi, the loss due to flooding would also be great. The amount of concrete for the project would be 3.3 million cubic meters, four times that of Zhexi; the investment would be 656 million yuan, over two times that of Zhexi, and obviously not in line with the technical and economic levels of the nation at the time; and even if it were operated, it could not be completed in time, and if it was abandoned halfway, it would mean a big waste.

We had a relatively successful experience at Zhexi; we had also learned the lesson of defeat at Zhelin. Zhelin was a project with an overall gain in power generation, flood prevention, and irrigation. It was close to the center of power consumption. Jiangxi Province indeed needed such a project at the time. Its [Zhelin's] economic indexes were also relatively good, but because we did not carry out sufficient surveys and research, because we did not sufficiently recognize the difficulty and complexity of the project, and because we did not clearly understand the geological conditions for a long time, the plans for the entire key project underwent many changes. Over 10 million cubic meters of earth were moved; Jiangxi Province's labor supply was scarce and the degree of mechanization was poor. Also, the commands were given blindly at the time. Thus, although Jiangxi Province exerted a lot of effort, construction was carried on for more than 3 years and the state invested about 70 million yuan, very little actual construction was accomplished, so in 1963 we were forced to abandon the project halfway, wasting over 30 million yuan and causing an unfavorable political effect. Later, we summarized the lesson from this undertaking and took account of the key geological conditions, and in 1971 construction was resumed; only in 1975 was the project completed and power generation started.

III. In determining the gain to comprehensive utilization of the project from planning and site selection, we must suit measures to local circumstances and to the project; we cannot make judgments subjectively.

Before planning and site selection, the nation generally has a preliminary requirement regarding the task of comprehensive utilization. The major points and secondary points of comprehensive utilization of the project must be clarified during planning and site selection. Basically, the major points must be satisfied, the secondary points must be taken care of, and the degree of attention must be determined by the conditions of the key project itself. But this primary and secondary relationship is very hard to determine. Sometimes there is a big difference between the two, even affecting the selection of the plan and site selection, so when differences emerge, we must carry out in-depth survey and research, and determine the primary and secondary relationship based on the greatest gain for the national economy.

When planning for the Zishui River valley, there was a serious difference of opinion regarding the major task of the first phase of construction--whether it should mainly be power generation or flood prevention. Those advocating that the major task should be flood prevention considered that the Zhexi reservoir would serve a small function in flood prevention on the middle and lower reaches of the Changjiang, and therefore Zhexi should be abandoned and the Shimoxi, with a huge reservoir capacity, or Xiushan should be selected. But actually, the amount of flood water of the Zishui constituted only 2 percent to 4 percent of the amount of flood water at the Chenglingji station, which was the exit station of Dongtinghu Lake, and the flooding period was 1 to 2 months earlier than that of the Changjiang. Controlling the flood waters of the Zishui would serve to prevent flooding of the Changjiang and Dongtingju Lake very slightly, while the cost due to flooding of the land and investment were great, so it would not be rational to abandon Zhexi and select Shimoxi, which had poorer conditions, would require a larger amount of construction, and had more flooded areas. Advocating the selection of Zhexi mainly for power generation was correct. This was because power generation would serve the major industrial area (central region) of Hunan greatly, and at the same time, power could be transmitted to the Dongtinghu Lake region, solving the problem of power for draining some 5-6 million mu of waterlogged farmland and the problem of power for elevated irrigation of 4-5 million mu. In addition, the Zhexi reservoir could also basically satisfy flood prevention of over 700,000 mu of farmland at the end of the Zishui.

When conditions are favorable, large-scale engineering projects mainly for electric power generation should develop their function of flood prevention and irrigation as much as possible. Power generation mainly provides industrial gain; flood prevention and irrigation provide direct agricultural gain. If both are present, the project can serve the national economy even more. The agricultural gain is especially important to projects with a large area flooded by the reservoir. Agricultural gain provides personal benefit to the local people. With the gain of flood prevention and irrigation, the broad masses can personally experience the function of the engineering project and actively support and facilitate the smooth progress of construction of the project. But while paying attention to the full development of the gain from comprehensive utilization, we must also prevent the influence of overly high demands by concerned units and avoid creating a loss for the state.

When studying the task of the comprehensive utilization of a key project, we must analyze the primary goals and secondary goals of the task, and we must also estimate possible future changes. For example, when construction of the Bailianhe key engineering project began, it was during the latter part of the 1950's when demand for power consumption was urgent. Therefore, the comprehensive utilization task of the project was determined mainly to be power generation, with secondary consideration for irrigation, flood prevention and transportation. But in 1959, drought occurred in Hubei and the demand for irrigation became outstanding, so the main task of the reservoir was changed to irrigation and then power generation. In actual operation, if there is a conflict between the two, power generation must give way to irrigation. Because at the beginning, the gradual increase in the use of water for irrigation was not estimated, the dimensions of the waterhead of the irrigation canals and the buildings of the canal system were too small, irrigation was not considered, and thus there was a delay of 1 year, causing a loss of about 20 million jin of food grains. Later, irrigation projects were considered, and with the support of the local government and the masses, although the latter construction period was during the difficult period, the project was still successfully completed.

Major floods frequently occur in the south-central region during the latter part of the flooding period. After the major floods, the runoff is very small, so the conflict between flood prevention and power generation is great. Flood prevention and power generation should be combined as much as possible so that the limited reservoir capacity can develop the gain of comprehensive utilization in many ways. During planning and site selection for Zhexi, the problem of combining flood prevention and power generation was not solved very well. At the time, in order to assure that the power generating reservoir capacity would always be full during hydrologically different years, the final date of filling was set for the end of June; thus, the reservoir could not carry out its flood prevention function in July and August. Later, during the preliminary design stage, the date for filling water for power generation was appropriately pushed back, and only in a few years will the reservoir not be at full capacity. From the point of view of power generation, pushing the water filling date back causes a small loss in generated electric power, but the function of flood prevention during July and August is tremendous. Although power generation and flood prevention are both not completely satisfied, the total gain is large. We call this method of combination "unified planning with due consideration for all factors, and mutual compromise."

IV. Planning and site selection must be revised and supplemented according to the change in the situation and objective conditions.

Because of development and change in the situation, information is constantly being accumulated and understanding will also deepen continuously, so the results of planning and site selection must also be constantly inspected and revised to adapt to the needs. For example, after the major flood in 1954, the problem of flood prevention became outstanding, and planning for the Yuanshui River took flood prevention as the major task for the first phase construction of the Wuqiangxi project. The key in planning and site selection was always placed on Wuqiangxi. Later, the state did not arrange for the construction at Wuqiangxi. By 1964, western Hunan required power consumption of a load of several hundred thousand kilowatts, and at the same time, we recognized that the normal high water level at Wuqiangxi was too high, and that the planning and site selection on the Yuanshui River must be revised; thus we turned to the tributaries Youshui and Qingshuijiang to find a site for the first-phase construction project, and the main task of comprehensive utilization also changed from flood prevention to power generation.

Sometimes, because of neglect in work, insufficient surveys and research, the results of planning and site selection also have to be revised frequently. For example, the plan for the Zishui included the survey of 45 damsites but missed the Jintangcong damsite, which had very good economic indexes and which would also irrigate and benefit over 1.8 million mu. Later, the results of planning and site selection had to be revised.

V. Planning hydroelectric power projects should reduce losses due to flooding; the work of moving and resettling the people must be done well to avoid adverse results.

The problems of flooding and the moving of people have become key problems in the present construction of hydroelectric power projects. Without solving the problems of flooding and the moving of people, hydroelectric power projects cannot be built. The population in the south-central region is dense, the average area of cultivated land per person is very small, the unit area yield is relatively high, the planned reservoirs are mostly large, the loss due to flooding is great and concentrated, and thus the problem of moving the people becomes more outstanding. In the past, we also paid attention to the problem of flooding, and we always strived to achieve no flooding or the flooding of less land, but in actual work, frequently we overestimated the gain and thus underestimated the effects of flooding. For example, in the Wuqiangxi project on the Yuanshui River, planning at the beginning overemphasized the gain in flood prevention and power generation, so when the reservoir capacity was enlarged (i.e., the high dam and large reservoir plan), 540,000 mu of cultivated land had to be flooded, a population of 380,000 (the figure at the time) had to be moved, covering 10 counties; also, of the problem of moving seven county seats was underestimated. Actually, it is very difficult to build a project of such a scale, whether at that time or now. But 20 years later, because the problem of energy sources had become severe, it was finally decided to lower the normal high water level of the Wuqiangxi project by 37 meters, thus reducing both the loss and the gain. The lowering of the normal high water level of the Wuqiangxi project was not because of limitations of the Fengtan Power Station on the upper reaches. It should be apparent that even without the Fengtan Power Station, it should not be higher. This reversal not only wasted a lot of time and capital, but it also delayed research work on the superior damsite of the Neiyuan reservoir region, on a tributary on the upper reaches, leading to a passive selection of the site later. In addition, many large reservoirs recently selected envisage the flooding of a large area, such as the Xiashan reservoir on the Ganjiang, which calls for the flooding of 290,000 mu. The Xiushan project on the Zishui envisages the flooding of 240,000 mu. The long-range plans for some reservoirs require moving a large population; for example, the plan to build a large reservoir of 3 billion cubic meters at Luojiamiao on the upper reaches of the Zishui required moving 119,000 people and flooding 182,000 mu of cultivated land, but it could only have an installed capacity of 90,000 kilowatts. At the time, the calculated total construction cost reached as high as 260 million yuan; the construction cost per kilowatt was 3,000 yuan--obviously unsuitable. But still we drilled 221 meters of holes, surveyed a 1:50,000-scale reservoir topographic map of 331 square kilometers, a 1:25,000-scale reservoir topographic map of 220 square kilometers, and wasted 30,000 to 40,000 yuan in capital.

In the past, when land was flooded and people moved, 200 yuan was given to each person for moving expenses (including all of the land and the house), accompanied by the sound of gongs and drums. Because of the inequity of the price, the problem of moving people was actually not solved and many problems remained. Later, the slogan of "returning the occupied land to the fields" was again proposed. But the good cultivable land in the south-central region is mostly distributed along the banks of the rivers, not on top of mountains, and with more people and less land, the good land has all been reclaimed. Therefore, while it is still possible to return the land occupied by small individual reservoirs under good conditions to the fields, the large and medium-sized reservoirs flood a large amount of cultivated land and basically returning the land cannot be realized. Therefore, when building large and medium-sized reservoirs, this slogan should not be used, and even if it is used it cannot be done.

Along with the demand to realize the four modernizations, we must gradually hasten hydroelectric power construction and we must also flood farmland and move people, but now each locality demands a high price for moving the people, and with the capital needed for construction, the asking price is too high; the problem also involves every sector and is very complex, and thus is not favorable to developing hydroelectric power as a priority. For this reason, it is suggested that the state should establish a "reservoir law" to rationally solve the demands and problems of the various sectors in order to hasten the steps toward hydroelectric construction.

Finally, let us consider opinions concerning planning and site selection of future hydroelectric power stations in the south-central region:

1. According to future long-term and near-term load levels (taking the near term as the main factor), we should establish the most economical order of development of new power generating projects. When the selected priority

development plan cannot be realized for some reason or when economically it becomes unfavorable, there must be backup projects for selection.

2. In the south-central region, the number of power source sites that can produce a big gain, that have a good regulatory nature, that produce a small area of flooding, that are economical in investment and that can be quickly constructed are few. In regions where the demand for power consumption is urgent, development of runoff power stations such as the one at Majitang downstream from the Hunan Zishui Zhexi Power Station, which utilizes the large reservoir that had already been built upstream to increase output, requires little flooding and construction is relatively simple. They are economical and reasonable. At the same time, consideration can also be given to gain a little more reservoir capacity by seeking sites where high and medium-level dams can be built which will flood only small areas and which are on medium or small tributaries upstream from power stations with reservoirs that have a poor regulatory function, so that the assured output of the downstream power station can be increased. In regions where the load of electricity consumption is high and where conditions permit, pump storage power stations can also be built.

3. Planning and site selection plans must be suited to the development of the national economy, they must be suited to the nation's financial and economic situation. Projects with good conditions and where the state's finances and material forces permit can be arranged first. We cannot exceed the state's financial and material strength. We must use the capital in the right place, or else we will expend greater effort and realize only half the result, even causing a big waste. This is not a new experience, but it provides a profound lesson to be learned from past and present occurrences.

9296
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HYDROPOWER, COAL, PETROLEUM, THERMOELECTRIC

WAYS TO IMPROVE ECONOMY OF SMALL HYDROPOWER STATIONS GIVEN

Beijing SHUILI FADIAN [WATER POWER] in Chinese No 8, 12 Aug 81 pp 44-45

[Article by Liang Zhaojia [2733 0340 0163] of the Hydroelectric Power Bureau of Fogang County, Guangdong Province: "Several Measures To Increase the Economic Gain of Small Hydroelectric Power Projects"]

[Text] Small hydroelectric power projects in farm villages require a small total investment, the construction period is short, and the masses can operate them themselves. As the development of small hydroelectric power projects is one way to strengthen the collective economy and solve agricultural consumption of electricity, all communes and brigades with water energy resources are willing to develop these projects.

Our county is situated in the northern mountain regions of Guangdong, where the water energy resources are relatively rich. The whole county's water energy reserves amount to 36,000 kilowatts; the portion which can be developed in the near future amounts to 13,000 kilowatts. To change the situation in the mountain regions, hydroelectric power projects were started in a big way in 1970. At present, the entire county has completed 165 small hydroelectric power stations with an installed capacity of 6,941 kilowatts (among them, the 32 stations which have been connected to the system of the electric power network have an installed capacity of 5,342 kilowatts), and has installed 36 kilometers of 35-kilovolt lines and 327 kilometers of 10-kilovolt lines. In all the communes throughout the county, 93 percent of the brigades and 90 percent of the production teams now have electricity. In 1980, small hydroelectric power generation reached 11.5 million kilowatt-hours, constituting 42 percent of the total amount of electricity used by industry and agriculture throughout the county, and this has served to help in solving the problems of the use of electric power in farm villages and in increasing commune and brigade revenues. Based on our experience in practice, to increase the economic gain of small hydroelectric power projects and improve the predicted results, we must suit measures to local circumstances during development and we must also do a good job of planning and design of small hydroelectric power projects.

1. Conscientiously Develop and Plan Step Power Stations Well

Rivers in mountain regions have a small surface area for collecting rain water, the fall is great, [the surrounding] vegetation is fairly good, the topography is fairly precipitous, and the amount of earth and rock in canals and channels is large. When planning for step power stations, we must utilize water energy resources to the maximum and we must also consider the difficulty and the economic rationality of developing each step power station. In particular, when selecting the design of the waterhead of the step power station, we must avoid "selecting the best for development" by utilizing only that part of the waterhead with a relatively concentrated fall and requiring a small amount of construction, while ignoring waterheads along the upper and lower reaches which are difficult to utilize. For example, the Jiuqu Power Station of Luodong Brigade in our county originally planned a waterhead of 62 meters for the power station, with a 1-mile-long canal and installed capacity of 160 kilowatts. Later, in the interest of speed, the head and tail ends of the waterhead were discarded and only the middle portion--34 meters--that was relatively easy to develop was utilized, the installed capacity was only 50 kilowatts, wasting nearly half of the waterhead, and as a result, it had to be rebuilt in 1979. This is a lesson that is worth learning. For power stations with high waterheads (waterhead of over 100 meters), when the waterhead undergoes a slight change affecting output only slightly, and when a lot of construction would be required to increase the waterhead by a few meters and would be economically irrational, these few meters of waterhead can be utilized or not utilized by the power station of the next step. The order of development of step power stations is not necessarily from top to bottom in gradual steps. Measures must be suited to local conditions: in general, those power stations with a large installed capacity, requiring relatively little construction and with short network lines should be given priority for development.

Development plans for step power stations that span communes or brigades should not be dismantled because of territorial limitations; negotiations should be conducted to establish joint operations so that water energy resources can be fully utilized.

II. Rationally Select the Installed Capacity and the Number of Generators

Our county built some simple power stations with only a few kilowatts of power at the beginning of the 1970's, but because their function was not large and because they were difficult to maintain, most of them have been abandoned. In the future, except for individual distant mountain villages, power stations of only a few kilowatts of power should no longer be built. Experience shows that the capacity of power stations built by production teams should be above 10 kilowatts, those built by the brigades should be above 40 kilowatts, those built by communes should be above 100 kilowatts to be suitable to the needs of power consumption in agricultural production.

For runoff power stations that have a small area for gathering rain water and that do not have regulatory reservoir capacity, in order to adapt to the changes in the amount of flow, the number of generators should be one large and one small. The flow capacity of the large generator should be two-thirds of the total amount of flow designed for the power station, and the flow capacity of the small generator should be one-third of the total amount. In this way, whether during the rich water period or the dry period, the generators can operate under better working conditions. Regarding the operating condition of the combined large and small generators of the many nonregulatory runoff power stations (over 100 kilowatts), the results have all been good and communes and brigades are all willing to build them.

III. Conscientiously Design the Draft Tubes

We understand from related information that the retrieval rate of energy in the tail water pipes of the mixed-flow type hydraulic turbines constitutes 15-18 percent of the output of the entire generator group. That of the propeller-type hydraulic turbines is even greater. Therefore, correctly designing the draft tubes affects the efficiency of the power station greatly, and they must be dealt with conscientiously. Practice shows that there are two measures to increase the rate of energy retrieval in the draft tubes: One is to lengthen the tail water pipes, while still satisfying the suction elevation. The efficiency of the 110 and 260 series mixed-flow type hydraulic turbines using draft tubes 1.8 meters to 2.2 meters long is best. The second is the rational selection and use of the exit-diameter of the draft tubes. Because ordinary small hydroelectric power stations mostly are runoff hydroelectric stations, the regulatory ability is poor, and during the year the amount of water changes greatly, so the exit diameter of the draft tubes must take into consideration adaptability to different amounts of flow. If the exit diameter of the draft tubes is determined simply according to the normal amount of flow, then during the dry period, the walls of the tubes will be dry, causing the generators to vibrate and reducing the efficiency of the hydraulic turbines. Conversely, if the exit diameter is determined by the amount of flow during the dry period, then during the rich water period, the exit speed of flow in the draft tubes is increased, the loss is greater and the output of the generators is reduced. Therefore, we must conscientiously make comparisons based on the actual situation to establish a rational exit diameter. The exit diameter of the draft tubes in use in our county is determined on the basis of the exit speed of normal flow--that is, between 0.8 meters/second and 1.0 meters/second--providing greater adaptability.

IV. Suit Measures To Local Circumstances in Selecting the Designed Flow and the Number of Hours of Utilization

The average rainfall over many years in our county is 2,100 millimeters. The designed flow of the nonregulatory runoff hydroelectric stations is established in accordance with the area of accumulation of rain water. Generally, for hydroelectric power stations with an area of rain accumulation of under 30 square kilometers when the vegetation is good, the flow is set at 0.04-0.045 cubic meters per second per square kilometer; when the vegetation is poor, the flow is set at 0.035-0.04 cubic meters per second per square kilometer. Hydroelectric power stations with an area of rain accumulation of over 100 square kilometers use a flow of 0.03-0.035 cubic meters per second per square kilometer. For hydroelectric power stations with an area of rain accumulation of 30-100 square kilometers, the flow can be chosen between the two described above. Based on the actual situation of our county, if the quality of the generators is good, if the quality of civil engineering and construction meets the design requirements, then the designed flow determined by the above method will enable the generators to reach over 3,200 hours of use. Based on provincial demands, the annual number of hours of utilization of ordinary power stations should be 3,500-4,000 hours, but considering that some communes and brigades have limited water energy resources and that rainfall is mostly concentrated from May to July, to fully utilize water energy resources, appropriately expanding the installed capacity and reducing the number of hours of utilization are also beneficial. For example, our county's Sanmen Power Station has a waterhead of 5.3 meters, the designed output is 400 kilowatts, the annual average output is 1,400,000 kilowatt-hours, and the annual number of hours of use is 3,500 hours. If we add a 160-kilowatt generator, an investment of 95,000 yuan is needed; each year it can generate electricity for 80 days, increasing the generated capacity by 300,000 kilowatt-hours. Based on the characteristic of our county having limited water energy resources, although the annual number of hours of use has dropped slightly to 3,036 hours, this is still beneficial.

V. Design the Canals and the Forebay Well

Based on the operating condition of the runoff hydroelectric power station in our county, the chances of silting of the canals is great, and when the amount of construction is not increased, the canal section should be 30-40 percent larger than the designed dimensions. The benefits of such enlargement are: first, if the canals are silted, the silting will not affect the normal flow of water; and second, if there are several step power stations upstream, then when the flow is intermittent and varies, the canal can serve to regulate the flow. To reduce the entry of sand into the canals, besides building sand draining floodgates along the river embankments and sand draining holes at a low height to increase the capacity for draining sand, we also need to give the entry floodgate of the power station a wide and shallow water entry section. If the normal depth of water in the canal is 1 meter, then a wall 80 centimeters high should be built at the entrance of the intake floodgate so that there is a wide, shallow entry section only 20 centimeters high in front of the floodgate. In this way, sedimentary sand below the 80-centimeter-high wall will not enter the canal, thus greatly reducing the amount of silting. For this purpose, and to reduce seepage in the canal and increase the rate of water utilization, the canal should have a water depth of 0.6 to 1.0 meter. The water should not be too shallow; wide, shallow canal sections should never be used. Although the results of preventing seepage by lining and by building a three-sided wall canal are good, the building cost is high; ordinary communes and brigades cannot easily afford to build such canals. The location of canals on precipitous mountain slopes where the soil texture is poor frequently has an effect on electric power generation because of mudslides during the rich water period. Measures should be conscientiously taken. For example, our county's Huyang Power Station lost 300,000 to 400,000 kilowatt-hours of electric power because of mudslides on the slopes each year during the first 4 to 5 years after it was built. Also, repair costs were necessary. Later, stone arches were used to cover the canal in the section of mudslides, thus eliminating the effect of the slides on the transport of water in the canal.

Experience with operating power stations shows that the depth of the water in the forebay should be deep under any conditions. This is especially suitable to variations in the instantaneous flow of the runoff power stations. The water intake tube in the forebay should have a water covering of 1.5 to 1.8 meters in depth. This way, when the water level drops slightly, the waterhead will not drop because of the occurrence of eddies or because of the intake of air.

VI. The Question of Whether the Small Power Stations Joining the Network Need Automatic Governors

Hydroelectric power stations with less than 320 kilowatts per generator joining the network should allow the voltage, the cycles and similar major electrical indexes to be controlled by the network after joining in. The generator of the power stations should only be able to carry out regulation of the ratio of work and zero work, and this type of readjustment should not be frequent. At the same time, when the generator and the network disengage, the station can solve the problem of speeding through water resistance; therefore, in small generators the function of automatic governors is not great, so their elimination can be considered in order to reduce the building cost.

9296
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GANSU'S FIRST LARGE THERMAL POWER PLANT GOES ON STREAM

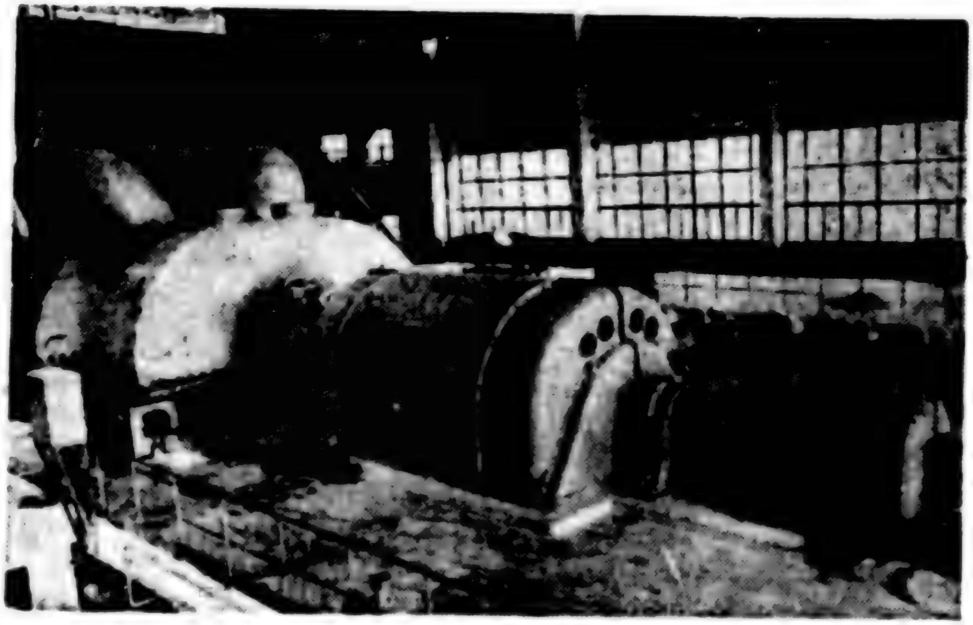
Lanzhou GANSU RIBAO in Chinese 5 Jan 82 p 1

[Article by Wang Baolin [3679 1405 1543] and Si Ma [0674 7456]: "Liancheng Power Plant Has Good News for the New Year, Our Province's First Large Thermal Generator Joins the Network and Generates Electricity"]

[Excerpts] On 4 January, over 4,000 construction workers and power plant personnel of the Liancheng Power Plant happily celebrated the completion of Gansu's newly built Liancheng Power Plant's first stage of construction of its 100,000-kilowatt generator which has now joined the power network and is generating electricity.

The Liancheng Power Plant is a major national construction project. The first stage of construction involves the installation of two 100,000-kilowatt double water cooled gas turbine generators and two 410-ton suspended high-pressure boilers. They are Gansu's largest thermal generators at present. The power plant is built in the Liancheng area inside Yongdeng County, situated at a point where the three power networks of Lanzhou, Hexi and Qinghai join together. The load center of the northwestern part of the Lanzhou power network, the plant is 14 kilometers from the Yaojie Coal Mines. A pit-mouth power plant, its completion and contribution to power generation will serve to modulate our province's hydroelectric and thermal power and will provide a new energy source for industrial and agricultural production and living.

The Liancheng Power Plant was designed by the Northwestern Electric Power Design Academy of the Ministry of Electric Power and was built and installed by 12 units including the Second Engineering Company of the Northwestern Electric Power Construction Bureau and the 101 Engineering Department of the First Company of the Provincial Construction Engineering Bureau. It is entirely equipped with domestically manufactured machinery and it is characterized by a new design and a new structure. During the course of construction, each construction unit strengthened Party leadership and went all-out to do good ideological-political work. At yesterday afternoon's ceremony celebrating the linking of the Liancheng Power Plant to the power grid and the inauguration of power generation, the construction command headquarters of the Liancheng Power Plant presented pennants to the 101 Engineering Department of the First Company of the Provincial Construction Engineering Bureau, the Liancheng Engineering Department of the Second Western Power Company, the workers' representative group of the Northwestern Electric Power Design Academy, the mechanized hoisting and installation team of the provincial construction engineering bureau. Responsible persons of the Provincial Construction Committee, the Provincial Planning Committee, the Provincial Economic Committee and concerned departments came to the site to meet with the builders of the Liancheng Power Plant, and they encouraged the broad number of workers to work hard during the new year as masters of their work and with the spirit of daring to create new things, to conscientiously implement the ten principles of economic buildup and to assure that the second generator joins the network to generate electricity in 1982 ahead of schedule.



Now part of the network and generating electricity.

9296
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BIG CAPITAL INVESTMENTS REAP MORE ELECTRIC POWER IN GANSU

Taiyuan SHANXI RIBAO in Chinese 11 Jan 82 p 1

[Article by Zhi Jun [1807 0193] and Jin Zheng [6855 6927]: "Our Province's Power Industry Generates More Electricity and Supplies More Electricity During Readjustment"]

[Text] Gansu has striven for speed on the battlefront of the power industry during readjustment to generate more electricity and to supply more electricity and to generate more income. The output in 1981 increased 3.1 percent over 1980 and 8 percent more profits were submitted than last year.

Last year, Gansu's electric power industry newly added an installed capacity of 299,000 kilowatts in power production and generation, and the capability of power generation increased 9 percent. While ensuring the supply of electricity for the whole province, Gansu's electric power industry has already transmitted 420 million kilowatt-hours of electricity to the Beijing, Tianjin and Tangshan power grid and the Hebei power grid, giving a boost to industrial and agricultural production in neighboring provinces and cities.

Gansu's power industry has actively solved the conflict of the imbalance between power supply and power consumption during readjustment. Forty percent of investment for capital construction have been used in power transmission and power transformer projects, and the projects were carefully organized, constructed, managed tightly and implemented. Last year, 341 kilometers of power transmission lines for over 110,000 volts were completed and began transmission. Power transformers with a capacity of 483,000 kilovolt-amperes were built, equivalent to ten times the transformer capacity of 1980, and 292 kilometers of 35,000-volt power transmission lines were newly constructed or rebuilt. Nine transformer stations were newly built or rebuilt with a total capacity of 28,000 kilovolt-amperes, and 2,933 kilometers of 10-kilovolt lines that were not up to standard were improved. Thus, the problems in some of the weak links of power transmission and power transformers and "bottleneck" problems were solved, and the main network structure of the power network was strengthened. This has turned the mismatched situation between power generation and power transmission and power transformers around and has created important conditions for the development of industrial and agricultural production in the whole province.

9296
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HYDROPOWER, COAL, PETROLEUM, THERMOELECTRIC

OVERVIEW OF GANSU'S SMALL-SCALE HYDROPOWER PROJECTS

Beijing SHUILI FADIAN [WATER POWER] in Chinese No 10, 12 Oct 81 pp 42-44

[Article by Wang Ruiting [3769 3843 1656] of the Second General Team of the Gansu Provincial Hydroelectric Power Design Institute: "Determination of the Installed Capacity of Small Hydroelectric Power Stations in Gansu and Some Problems in Their Operation"]

[Text] Gansu has already built over 600 small hydroelectric power stations with a total installed capacity of 110,000 kilowatts. What are the problems in the design of these small hydroelectric power stations? Is their operation rational? What are their economic benefits? These questions have caught the attention of concerned sectors. This writer will present his opinions concerning the selection of the installed capacity of small hydroelectric power stations and problems in operation in the hope that they will stimulate further discussion and study to promote a steady and healthy development of small hydroelectric power stations in our province.

I. Selection of the Installed Capacity and the Operation of Small Hydroelectric Power Stations in Recent Years

The selection of the installed capacity of some of the small hydroelectric power stations in our province was generally determined by the number of hours of economic utilization of installed capacity combined with the degree of development of hydraulic energy and the load demand of the locality. The number of hours of economic utilization was generally based on 4,000 hours as the lower limit of overlapping capacity of the large and medium sized power stations of the upper reaches of the Huanghe during the "Second Five-year Plan" and the "Third Five-year Plan" periods. The installed capacity of some of the power stations was determined by calculating the output generated by the average flow of rivers or the average flow of irrigation canals. Because the method of design was overly simple, indicators of hydraulic energy lacked sufficient precision. In particular, they lacked strict technical and economic proof, therefore, arbitrariness in the selection of the installed capacity was great. Table 1 lists the installed capacities of several power stations already completed.

Table 1

Item	Unit	Name of Power Station Longqu	Suoertou	Shangde	Yuanyangchi	Shidahe 1st Step	Shuangshushi
Installed capacity	kilowatts	6400	6400	2500	1890	1260	1260
Yearly power output	10,000 kilowatt-hours	4300	3927	2170	1490	745	555
Hours of utilization of installed capacity	hours	6720	6130	8680	7880	5910	4410
Assured output	kilowatts	3390	2740	2450	1130	0	0
Percentage of assurance	percent	85	85	95	85	none	none
Designed waterhead	meters	30.5	30.5	21.0	26.2	26.2	45.6
Flow volume to generate power	cubic meters per second	24.8	25.2	16.2	9.0	6.25	3.72
Type of power power station		dam diverted	diverted without dam	diverted without dam	mixed	mixed	mixed
Regulatory function of reservoir		none	none	none	Multiple-year regulation for irrigation	Multiple-year regulation for irrigation	Multiple-year regulation for irrigation
On which river		Heihe	Bailongjiang	Baishuijiang	Taolaihe	Xidahe	Hongshuihe
In which county		Zhangye	Zhouqu	Wenxian	Jinta	Yongchang	Minle

Table 2

Item Name of Power Station	Installed capacity (kw)	Yearly power output (10,000 kw/hr)				Number of hours of utilization of installed capacity				Construction cost (10,000 yuan)	Average annual operating cost (10,000 yuan)	Aver. elec. power cost (fen/kw/hr)	Price of elec. (fen/kw/hr)	Aver. revenue of elec. fee (10,000 yuan/yr)	Aver. Net Income (10,000 yuan/yr)	Number of years for return of construc. cost	Network Status
		1978	1979	1980	Average	1978	1979	1980	Average								
Longqu	6400	1800	2530	3200	2510	2813	3953	5000	3922	1000	44.2	1.76	5	125.5	81.30	12.3	Joined network
Yuanyang-chi	1890	700	804	663	722	3704	4254	3508	3822	220	11.17	1.54	5	36.1	24.93	8.8	Joined network
Xidahe first step	1260	180	200	216	198.6	1428	1587	1714	1576	110	3.93	1.97	5	9.93	6.00	18.3	Joined network
Shuang-shushi	1260	120	129	191	146.6	952	1024	1516	1164	100	3.69	2.51	5	7.33	3.64	27.5	Not yet joined network

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Notes: 1. Here, the price of electricity is the statistical value of the price of electricity of hydroelectric power in the Hexi region in 1980.

2. The number of years for return on construction costs does not include interest

Table 3

Item	Unit	Longqu Power Station	Yuanyangchi Power Station	Xidahe Power Station	Shuangshushi Power Station
Assumed recovery rate	%	8.7	11.5	6	4
Total construction cost plus interest during construction	10,000 yuan	1134.30	259.40	120.09	106.08
Annual operating maintenance cost	"	24.20	6.77	2.64	2.40
50-year maintenance costs based on current value	"	273.86	58.61	41.61	51.55
Total costs at current value	"	1408.16	318.00	161.70	157.63
50-year total income based on current value	"	1420.15	312.26	156.51	157.44
Total income minus total cost	"	11.90	-5.74	-5.18	-0.18

Notes: 1. The current value of total income over 50 years uses the annual income of electric fees; see Table 2 for the average income.

2. The construction period of each power station is 1.5 to 2.5 years. Calculations here are based on 2 years and a projected life of 50 years.

The dynamic indicators of each power station listed in Table 1 are relatively good but the number of hours of utilization of the installed capacity is between 4,410 and 8,680, almost a onefold difference. The variation is large. Are they rational? In most designs, technical and economic analyses were not carried out. After inspecting their operation for several years, the results showed that many problems indeed existed in past selection of installed capacity. Their main manifestations are as follows: The selection of the sites of the hydroelectric power stations lacked regional hydraulic energy planning as guide. The relationship of supply and demand between the electric power and the output of electricity at the locality was not carefully considered. Necessary technical and economic analysis and a unified scientific operations management system were neglected. Thus, the gap between the results of actual operation and the original design was relatively large and the economic benefit was relatively poor. At present, the small hydroelectric power stations in the farm villages in the Hexi area (those with an installed capacity below 500 kilowatts) produce an even poorer economic result. According to statistics of 125 small hydroelectric power stations in the Hexi area with total installed capacity of 10,029 kilowatts, the total output of electricity in 1979 was only 7.287 million kilowatt-hours. The average number of hours of utilization of installed capacity was only 727, obviously, most of the power stations suffered a deficit. The benefits from the operation of small hydroelectric power stations with installed capacity larger than 500 kilowatts are slightly better. Statistics on the operation of 4 such power stations of nearly three years show there are greater differences between their dynamic indices and their designed indices, see Table 2.

The designed indices of the average output of electricity during the three years of operation as listed in Table 2 are between 26.4 percent and 58.4 percent. The corresponding number of hours of utilization of the installed capacity is between 1,164 to 3,922. Thus, it can be seen that the rate of utilization of the facilities is very low. The four power stations that have been in operation for 3 to 5 years have not reached their designed indices of output but the differences are not the same. The output of electricity of the Longqu Power Station and the Yuanyangci Power Station is higher because they have a higher designed assurance rate, a larger assured output, and because their reservoirs have a better regulatory function, and their rate of utilization of the facilities is higher, while the seasonal power stations of the Xidahe First Step Power Station and the Shuangshushi Power Station which are mainly for irrigation generate less output and their rate of utilization of the facilities is lower. The reasons are as follows:

1. Longqu and Xidahe First Step and the Shuangshusi Power Stations are all within the large Lanzhou power network. The large and medium sized power stations of Liujiaxia, Yanguoxia, Bapanxia on Huanghe are the backbone power sources of this network. Their regulatory function is relatively poor (the Liujiaxia Power Station is the only one that does not serve a full annual regulatory function). The seasonal electric power of the hydroelectric power station during the high water period from July to September is rich but there are not enough corresponding seasonal users of electric power. Therefore the power output capabilities of the small hydroelectric power stations in the system are limited. This limitation visibly affects the annual output of

electricity of the Xidahe First Step and the Shuangshushi Power Stations. Therefore, the annual duration of power generation of this type of power stations is only 7 months (from April to October). Frum July to September, a lot of water is used for irrigation. Originally, there should be more output of electricity but because the system has a surplus of electric power, therefore at this time, these power stations not only can satisfy the need of the regional load, they must also abandon some of their water resources, and thus, the annual output of electricity becomes deficient.

2. The installed capacities were too large or overlapping construction reduced the designed output of electricity of the power stations which had already been built. The purpose of building most of the small hydroelectric power stations was to satisfy the need of regional loads. Because the estimates of the designed loads were too high, the installed capacities of some of the small hydroelectric power stations selected were too high, or soon after they joined in production, similar types of hydroelectric power stations were constructed. There were overlapping projects. For example, the installed capacity of Xidahe First Step Power Station was 1,260 kilowatts. It had been operating for 7 to 8 years. Its highest load was about 1,000 kilowatts. Its average load was 600 kilowatts. The supply and demand for electric power were basically balanced. But not long ago, the Xidahe Second Step Power Station of the same capacity was built at its lower reaches, thus, the two stations had to generate electricity alternately, sharply reducing the output of electricity of the single station. Also, for example, the installed capacity of the Shuangshushi hydroelectric power station was 1,260 kilowatts. It had been operating for 6 to 7 years. Its highest load was 900 kilowatts. Its average load was 400 kilowatts, and in ordinary times, it could only operate at half capacity.

3. The Yuanyangci Hydroelectric Power Station has joined the Jiu (Jiuquan) - Jia (Jiayuguan) power system. The major power sources of this system are large and medium sized thermal power plants. The load is not large enough. The capacity of the thermal power plants has accumulated. And with the lack of procedures for scientific operations and regulation, even though the reservoir of that hydroelectric power station has a relatively good regulatory function (there is a reverse regulating reservoir at the lower reaches), the capability of generation could not reach the designed capacity.

The analysis of the benefits in Table 2 does not take into consideration the interest on capital. If future capital investment for construction is changed to loans, then the construction cost, the annual interest rate and the compound interest rates of the revenue should be considered. The results of calculating the benefits of the 4 power stations using the "internal recovery rate" method (See "Shuili Fadian" No 3, 1980: Economic Analysis of Hydraulic Power Engineering Projects) are listed in Table 3.

According to the preliminary analysis in Table 2 and Table 3, if the number of years for return on investment is set at 8 to 12 years (not calculating interest), or if we consider the annual interest and compound interest on investment and set the annual interest rate at about 10 percent, then, the economic benefits of the Longqu and Yuanyangci Power Stations are good but the economic benefits of the Xidahe First Step and the Shuangshushi Power Stations are very poor.

Summarizing the above situation, we believe that because the Lanzhou power network uses large and medium sized hydroelectric power stations as the main power sources, and because the regulatory function of the hydroelectric power stations are poor, therefore, the assured output is relatively low while the output of seasonal electricity is abundant. The present seasonal electricity users are not sufficient in number, and thus supply has surpassed demand. Therefore, in the system, the seasonal output of the small hydroelectric power stations that combine electricity generation with irrigation is limited. In view of the number of hours of utilization of the installed capacity of small hydroelectric power stations, the economic benefits should be more visible when the number of hours of utilization is above 4,000 hours. But the number of hours of utilization of the installed capacity of the small hydroelectric power stations which generate electricity during the irrigation season is only between 1,000 and 1,500 hours, far below 4,000 hours. Therefore, the region of the Lanzhou power network is unsuitable for building this type of power station. The number of hours of utilization of installed capacity of the mixed or diversion type hydroelectric power stations (such as Longqu and Yuanyangci Power Stations) which have a relatively high regulatory function, assurance rate and assured output approaches 4,000 because they generate electricity year-round. Their output is relatively stable. The quality of electricity is relatively high, and the economic benefits are more visible. After technical and economic analysis, this type of power stations is still worth developing at the lower reaches of reservoirs situated at places where water is relatively plentiful, across river sections that have a concentrated drop or at places where the reservoirs can serve irrigation and year-round generation of electricity.

II. Several Suggestions

1. We must strictly grasp the procedures of capital construction. In particular, small (1) power stations should be based on local power plans and plans to develop hydraulic energy. We must insist on feasibility studies and necessary procedures of surveying, designing and construction to overcome blindness in construction.

2. The government agencies and electric power management departments should study and establish related economic policies for building small hydroelectric power stations and post economic indicators. For example: interest rates on loans for small hydroelectric power stations, managerial authority, method of distributing profits should be posted and regional prices for electricity should be based on quality of electric power to provide a reference for designing these power stations.

3. Precision of dynamic designs should be improved. (1) Improving the precision of calculation of the indices of hydraulic energy: First, hydrological data must be checked and then the method of calculation should be selected according to the precision of hydrological data and the regulatory function of the reservoir. When the hydrological series of reservoirs that perform annual and seasonal regulatory functions is relatively short (10 to 20 years), the monthly average flow can be used in calculating the regulatory function of the whole series of reservoirs. The effects of the parameters of a step reservoir on the hydraulic energy indices of a step power station should be considered in the

stepwise development of rivers (sections). The parameters of a step reservoir and the hydraulic energy indices should be selected by taking into consideration the hydraulic energy indices of future steps based on the load demand of the designed level year. When the hydrological series surpasses 20 to 30 years and to simplify computation, we can select a representative hydrological section (multiple-year regulation) or a representative year (annual regulation) to calculate the hydraulic energy indices. If the reservoir performs a daily regulatory function, then, we should select the average daily flow of a representative year for computation. If it is a run-off type power station, we should also analyze the daily variation of typical flow and the hydraulic energy lost because of the asynchronism of the load curves, and we should revise the hydraulic energy indices calculated on the basis of the average daily flow. The effects of mud and sand and icicles on the small hydroelectric power stations are also relatively serious in our province and they should be specifically analyzed. The hydraulic turbines of reservoir power stations mainly serving irrigation are frequently jammed because the water level has dropped too low. These factors will all cause the hydraulic energy indices to drop and they should be considered in the design. (2) Regional load data should be gathered. Typical daily load graphs should be compiled to prove the economic rationality of the operating capacity and the various reserve capacities of a power station by balancing power generation and output so that the operating method of this power station in the system can be understood.

4. Power stations should be developed and installed in stages. Our province's Wudu and Gannan regions are situated at the upper reaches of the Bailongjiang and the Yaohe. Hydraulic energy resources are rich and conditions for development are superior. According to the conditions of these hydraulic sites, we can often install a capacity of over 10,000 kilowatts. Their economic rationality for development and installation in stages should be studied. They should not be completed at once to avoid accumulation of investment.

5. When the installed capacity of the small single backbone hydroelectric power station as a percentage of the installed capacity of the small power network is large (such as 30 percent to 40 percent), the appropriate number of generators should be 3 to 4 units. This is beneficial to improving the versatility and reliability of operation of the power stations. At present, certain small backbone hydroelectric power stations in the Hexi region have two generators. They are not sufficiently versatile in regulating the loads, and when one unit is being inspected and repaired, the generators operate under reserve conditions without breakdown and safety is relatively poor.

6. More small hydroelectric power stations with good regulatory functions, a higher rate of assurance and assured output should be built to improve the reliability of power supply of the small hydroelectric power stations. Of the small hydroelectric power stations that have already been built in our province, very few have a good regulatory function. Although the output of seasonal electric power is relatively abundant, the assured output is very low. For example, the three localities of the Hexi region have already built 130 small hydroelectric power stations. But in winter, only several power stations of Lungqu and Yuanyangci generate electricity, [illegible]y weakening the function of the small hydroelectric power stations to s[illegible]gional loads. At present,

construction of small hydroelectric power stations should emphasize the border mountain regions. Practice has proven that it is feasible for these regions to produce and sell their own electric power. In the area of the province's large power network, small hydroelectric power stations that generate power seasonally should not be built because they would create difficulties for the large power network and in fact would also create difficulties for the state. Sites should be selected along river sections where hydraulic energy is relatively concentrated and where there are reservoirs with relatively good regulatory functions. These sites should be screened after conducting an overall comparison with the power transmission of the large power network.

7. Studies in the utilization of seasonal electric power should be developed in a big way. At present, there is a surplus of seasonal electricity and the users are few. To improve the economic benefits of small hydroelectric power stations, we should find users for seasonal electricity. Our province's Wudu area once proposed the development of electrolytic water to manufacture nitrogeneous fertilizers. The central arid regions can develop small electric power to draw water for irrigation. The Hexi area can develop electric power for well irrigation and for processing agricultural sideline products. These studies all have practical significance and they should be investigated and studied. Measures to encourage the utilization of seasonal electricity should be established to fully develop the superiority and the benefits of our province's small hydroelectric power by suiting measures to local circumstances.

9296
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HYDROPOWER, COAL, PETROLEUM, THERMOELECTRIC

HYDROPOWER DEVELOPMENT STEPPED UP AS GANSU'S FORESTS SHRINK ALARMINGLY

Beijing SHUILI SHUIDIAN JISHU [WATER CONSERVATION AND HYDROELECTRIC POWER TECHNOLOGY] in Chinese No 12, 20 Dec 81 pp 33-35

[Article by Qian Zhenyong [7505 2182 3057] of the Water Conservancy and Electric Power Bureau of Zhuoni County in Gansu Province: "We Must Actively Develop the Hydraulic Resources of the Taohe Segment in the Zang Autonomous Zhou in Southern Gansu"]

[Text] (1) The River Valley

Taohe is situated in the mountainous region of southern Gansu Province. It is a relatively large tributary of the Huanghe. It originates in the Xiqingshan at the juncture of the three provinces of Gansu, Qinghai and Sichuan. It flows through Luqu, Xiahe, Zhoni, Lintan counties and enters the Huanghe at Yongjing. The total area of the river valley is 31,800 square kilometers. The total length of the river is 580 kilometers. The river segment inside the Zang Autonomous Zhou in southern Gansu is 400 kilometers long. The specific drop of the river bed is 0.28 percent. The area of the river valley there is 17,000 square kilometers. There are 3,504,000 mu of forests in the river valley area. The forest coverage is 18.6 percent. There are over 10 million mu of brush-covered mountains. The area of cultivated land is 900,000 mu. The annual average rainfall is 670 millimeters. The average flow over many years is 95 cubic meters/second. The annual runoff totals 2.8 billion cubic meters. The peak flow during a major flood occurring every 50 years is 1,500 cubic meters/-second. According to estimates, the theoretical reserve of hydraulic resources is about 1 million kilowatts, constituting over one-tenth the reserve of hydraulic resources of the whole province. The area is a rare natural treasure chest of energy.

(2) Farm Villages Lack Energy Which Has Led to Forest Depletion

In the 30 years since Liberation, because the farm villages do not have a sufficient understanding of the energy problem, and especially because the river valley region lacks mineral fuel, the whole region's people and masses have to fell wood as fuel for cooking and for warmth. This not only requires a lot of labor, it also destroys natural forest resources. According to statistics compiled by the forestry departments, over the past 30 years, 195,000 mu of forests in the entire forest region of Taohe have already become sparse, 208,000 mu have become an area of shrubs, and 55,000 mu have become barren mountains. Because the population continues to increase in recent years, almost a thousand people go into the forest to fell trees every day. Each year, 352 million jin of firewood are burned. Calculating at 0.8 tons per cubic meters of forest trees, equivalent to burning 1,200,000 trees of 10 centimeters in diameter and 5 meters in height each year. With the addition of the amount of firewood for daily living needs consumed by agencies, enterprises and troops and loss due to natural disasters, total consumption a year is over 320,000 cubic meters. If this amount of timber is used as poles for high voltage power lines of 6 to 10 kilovolts, they would extend 4,800 kilometers. Each year, the net increase in accumulation of forest wood is only 340,000 cubic meters. If we add the amount taken by the forestry departments for production, for logging, for processing of forest sideline products, annual consumption will surpass growth by over 100,000 cubic meters, and thus, natural resources are being destroyed more and more severely every day.

Engels pointed out more than 100 years ago: Mesopotamia, Greece, and Asia Minor cleared all the forests for farmland. Therefore these places have become barren land. Because these places lost their forests, they also lost their water sheds. The Italians felled all the pines on the northern slopes of the Alps. Not only was the livestock industry in the high mountains destroyed, during the rainy season fierce floodwaters pour onto the plains. If we do not solve the energy problem in the farm villages and if we allow the situation to develop for a long period in the future, the Taohe river valley will repeat the mistakes of the Italians, and the future will bring a gradual depletion of forest land and continued increase in soil erosion. And because the soil is poor and infertile and because the soil fertility is weak, the ability of the land to resist disasters will drop gradually and the ecological balance of nature will be threatened. This will not only affect agricultural production, it will also affect the development of the four modernizations of the entire region. Therefore, the important problem facing us at present is to emphasize protection and building the forests to maintain a new ecological balance. To achieve this goal, the urgent task is to exert efforts to find and to open up new energy sources. This will be a historical task faced by our generation.

(3) Utilize water resources to create conditions for the development of industry, agriculture and livestock production

Southern Gansu is a region where a national minority resides. Because of historical reasons, the industrial foundation is relatively weak. The shortage of energy has also become the greatest hindrance to the development of local industry in a big way. Although there are some potential and favorable conditions for forestry and livestock production, forestry production has already conflicted with the shortage of energy resources. In agricultural production, because the area averages above 2,000 meters above sea level, the high altitude climate, the cold climate, the overcast and damp climatic conditions have greatly affected the yield of food grains. The various reasons mentioned above and the ten years of upheaval by the "gang of four" have seriously destroyed industrial and agricultural production. The people's life was not improved, and the national economy of the entire region did not develop rapidly.

How can we hasten the progress of building the "four modernizations"? Obviously, again relying on a singular agricultural economy would not work anymore. Relying on the development of forest resources will not work because the felling rate has surpassed the growth rate and massive development is limited. If we do not see this and live off the mountains, we will consume everything until there is nothing. Relying on the development of local industry will be difficult because the southern Gansu area is situated in the border regions where transportation is not convenient, and there are difficulties with raw materials, fuel and power. Therefore, to enable industrial, agricultural and livestock production to develop, we must solve the problem at its roots. We must start out from energy and actively develop the energy industry. We must "rely on water for a living," fully develop the superiority of water resources and carry out large scale hydroelectric construction.

In this way, a strong motive force can be provided for the development of local industries. And also, later worries of developing forestry and livestock production can be eliminated. We can thus promote and push forward the overall development of industrial, agricultural and livestock production of the regions of the national minorities from the root, and at the same time provide favorable conditions for improving the living standards of the people and the masses.

(4) The Present Situation and the Outlook of Developing Hydraulic Resources

At present, the development of Taohe is not ideal. The Dushan Power Station that has already been built has an installed capacity of only 1,600 kilowatts. Including the Xiacun Power Station that is being built and the Duojiashan Power Station that has already begun preliminary designing and planning, the total installed capacity would only amount to 12,000 kilowatts. This is only one-hundredth the reserve of water resources of the region.

The planned investment in the Duojiashan Power Station currently being designed is 10,000,000 yuan. It will divert a flow of 45 cubic meters/second. Its designed water head is 18 meters. Its installable capacity is 6,000 kilowatts. Each year, it can generate 40,000,000 kilowatt-hours of electricity. Each kilowatt-hour of electricity averages ten cents. Each year, it will have an income of 4 million yuan. It would take only three years for the station to recover all its investment. If the principle of assuring cost and seeking slight profits is followed, the cost of each kilowatt-hour of electricity can be reduced to 2 to 3 cents. This will enable the masses of the entire region and the agencies to use electric stoves for cooking and for warmth. This will not only change the living conditions of the people and masses greatly, more importantly, this will protect the rich forest resources and maintained the ecological balance in nature.

At the same time, the northern part of the southern Gansu region neighbors Linxia and the eastern part connects with Min Xian. The two places can both be connected to the national power network. We can imagine, if we use the method of the hen laying eggs to build one or two medium sized power stations first, then within a dozen years, we can gradually develop and build several and even a dozen step power stations so that one tenth of the water resources can develop its function and this will surely create a new political and economic situation in the whole region and this will also create a new jump in the people's living standards of the region of the national minorities.

(5) The Guideline of Developing Hydraulic Resources and Exploration of the Method

There are two points that need to be discussed when talking about the problem of how to develop hydraulic resources of the segment of Taohe in southern Gansu. One is the guideline for development and the second is the method of development.

1. The guideline for development can be a form of joint operation by the country and the communes, but mainly "public" operations. This involves investment by the state, national construction and national management. In the past, communes and brigades have built some small power stations along small tributaries. The state appropriately subsidized the projects with funds. This has definitely served to solve the problems in lighting for the border mountain regions and for agricultural sideline processing industries. But practice of several years has also made us feel that if we do not talk about concrete conditions, "commune operation with public assistance" as the guideline for basic level hydroelectric construction would not be suitable. Because, in some remote mountain regions, a long period of economic and cultural backwardness created by the social environment has created many problems in construction and development of the regions. Some problems are related to the lack of an ability to carry out construction and the postponement of the construction period. Some problems are related to the low technical standard and the unstable quality of construction, leaving hidden dangers in construction projects for long periods. In many construction projects, management could not catch up after completion of the projects. Not long after production began, accidents frequently occurred. Some construction projects even could not function for long periods. As a result, "the nation spent money, the commune members exerted efforts, but the masses could not benefit."

Since 1968, Zhuoni County had built 15 small hydroelectric power stations during the 12 years. One was publicly operated. One was operated first by the commune but later it changed hands and it was operated publicly. The rest were all "commune operated with public assistance." In actuality, the communes and brigades provided the labor, the electrical equipment and machinery, building materials all came from national investment of over 3 million yuan. After completion, their performance showed that the county operated one had complete facilities and over the last 10 years it has earned an income of over 1.5 million yuan, and it has submitted 580,000 yuan of profits. Of the other power stations, 60 percent operated in a handicapped fashion, and 20 percent operated at only half capacity. There were 20 percent that had already been abandoned. The nation did not accumulate any benefits. Even maintenance of the facilities could not be handled by the localities. Here, the main reason was that the management standard was too low. As we carry out the four modernizations, we must use economic means and talk about economic results. This method of producing poor economic results obviously is very unsuitable.

2. The method of development should mainly be the development of riverbed type step power stations. In the past, when building a power station, development is traditionally in one direction. Either the diversion type or the mixed type, the same over and over again. But according to the natural conditions of the Taohe River valley, the development of the riverbed type power station should be actively advocated.

(1) The specific drop of the riverbed of Taohe is large. Especially at the upper reaches in the counties of Luqu and Zhuoni, the average specific drop is about 0.3 percent. At some segments of rapid flow, this even averages over 1 percent. Therefore, using the riverbed type development, a low waterhead and a large flow to seek a natural waterhead of 3 to 4 meters is very easy.

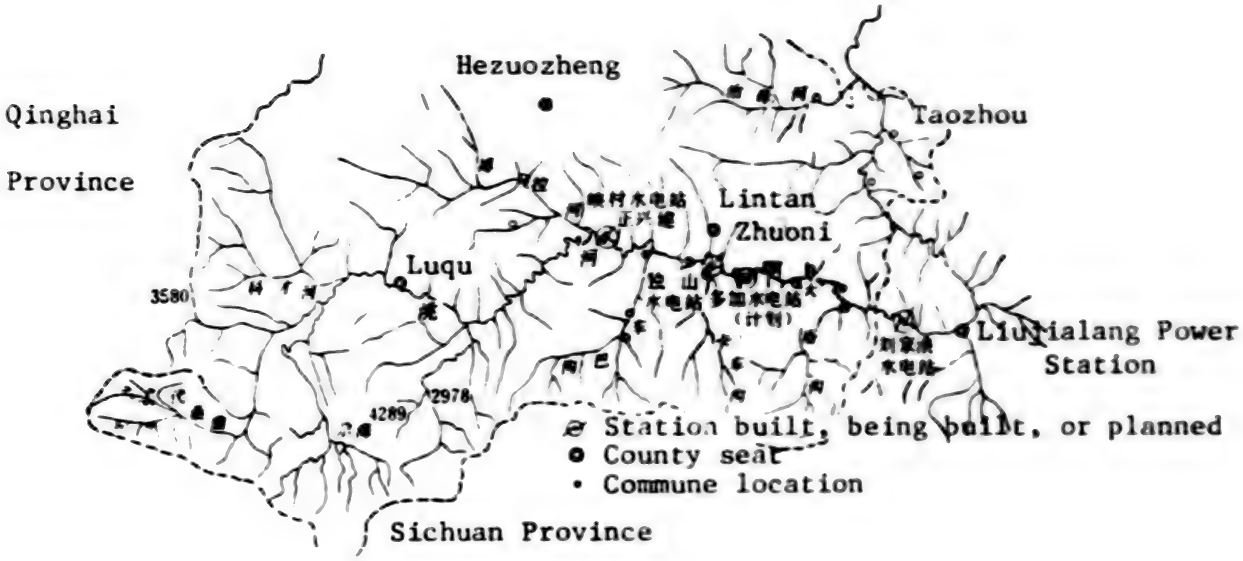
(2) The riverbed section is regular and buildings are easily placed.

(3) Most of the high yielding farmland in the Taohe River valley are located in the river valleys and flatland. The riverbed type power station has a small area for backup water. As long as the selection is appropriate, we can almost avoid flooding farmland and farm houses, and the production and life of the masses will not be affected. Of course, this will not increase forced migration of the population and the cost of compensation of property loss.

(4) "Floating pearls" of Taohe (also called ma fu 7802 3187 floating ice) are a famous sight of southern Gansu. But they have caused many problems for hydroelectric power stations during winter. In particular, because the diversion type power stations have a long diversion route and a small longitudinal slope, water in the river and cold air easily come into contact and produce an overly cold state which lasts for a long time. This creates a great difficulty for ice draining facilities. Especially when using mixed flow type generators, the water passageway is easily blocked by ice because of the characteristics of the structure of the turbine blades in the sluice. The riverbed type power station uses axial flow type generators. The waterhead is low. The flow is large. Diverting water underneath the ice can solve the problems caused by the "floating ice," and the problem of allowing the ice to pass through the turbines is solved. This way is more favorable to operating the power stations in winter.

(5) Because the specific drop of the river bed is large, the natural topography is good, a station site can be chosen at an average of every 10 kilometers (see the illustrated diagram for the development of hydraulic resources of the segment of Taohe in southern Gansu). The segment can be developed by building step power stations. A group of power stations can be built. This will also facilitate the establishment of a modern management system. It would be convenient for scientific experiment and it would also be favorable to safe production.

In general, the energy problem today has already become a major problem facing the world. The situation in our nation is not an exception. Whether in economic construction or in protecting natural resources and maintaining ecological balance, we should include the development of hydraulic resources of the segment of Taohe in southern Gansu and the efforts to solve the energy problem and protect forests in the agenda for developing the regions of national minorities.



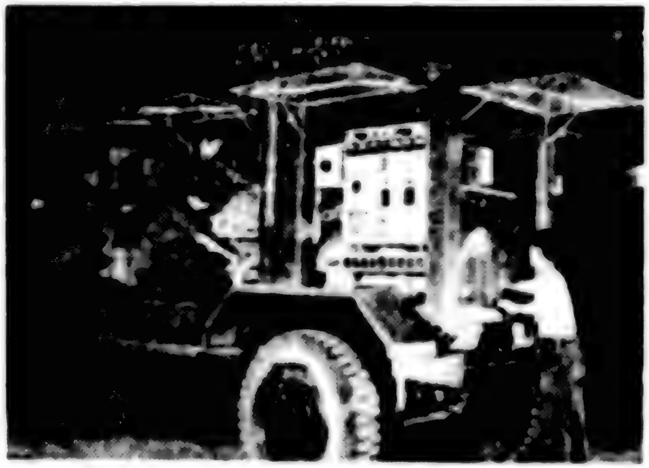
Map showing the development of hydropower resources of the segment of the Taohe in the southern Ganzu Zang Autonomous Zhou.

9296
CSO: 4006/294

200-KILOWATT MOBILE POWER STATION MAKES ITS DEBUT

Shenyang LIAONING RIBAO in Chinese 12 Jan 82 p 3

[Text] The Zhengzhou Electrical Equipment Plant has developed the GT series of 20- to 200-kilowatt mobile power stations, supplying fresh motive power for the building of the Four Modernizations and winning for itself commendations from the Party Central Committee, the Central Military Commission, and the State Council. Shown in the photograph is China's largest mobile power station --a 200-kilowatt generator.



CSO: 4013/1

HYDROPOWER, COAL, PETROLEUM, THERMOELECTRIC

'JINGJI GUANLI' ON SAVING ENERGY IN COAL INDUSTRY

HK010837 Beijing JINGJI GUANLI in Chinese No 12, 15 Dec 81 pp 28-30

[Article by Mei Yan [2734 1484]: "Development of Coal-Washing and Dressing Is an Effective Way of 'Saving Energy'"--note passages within slantlines denote boldface type]

[Text] Coal is a precious nonreproducable natural resource. Its economic and rational utilization to achieve the best possible economic results with the least energy consumption is an important requirement for the healthy development of the modernization construction of our country. Under the circumstances whereby for the present and for a considerably long time to come it will be difficult to boost energy production by a large margin, the development of coal-washing and dressing in order to enhance the effective utilization of coal is a task of top priority at present as well as an important policy for changing the coal product structure and for developing the coal industry.

The Low Level of Coal Dressing Is an Important Cause of High Energy Consumption

Since the founding of our People's Republic, the coal industry of our country has been developing rapidly. The production of coal has increased by more than 200 percent. However, our utilization rate of thermal energy of coal is very low. It is only 20 percent, whereas such rates in advanced countries abroad have attained about 60 percent. The per unit energy consumption of the products of the major industrial departments of our country is also much greater than that of the advanced foreign countries. Coal consumption per ton of steel in steel making is 1.5 tons in our country, whereas that of Japan is 0.681 tons, and that of West Germany 0.748 tons. Ours is twice as much as those of Japan and West Germany. In iron smelting, coking coal wed per ton of iron made is 553 kilograms for our country, and that of Japan is 430 kilograms, 123 kilograms less than ours. For electricity generation, coal consumption per kilowatt-hour of electricity generated is generally 350 grams in countries abroad, while it is 420 grams in our country, 20 percent higher than those abroad. Of course, there are various reasons that account for this high consumption of energy. Undoubtedly, the low level of dressing, irrationality of product composition, lack of variety and poor quality are all important reasons. As indicated by the analysis of the department concerned, for the waste of coal consumption 35 percent is due to poor management of energy, and 65 percent is due to the inability of technological equipment to adapt to the varieties and quality of coal.

Our country is one of the coal producers of the world as well as the topmost country in terms of direct coal sales and consumption. The small capacity of coal dressing, low percentage in coal washing, and the irrational utilization combine to explain the most grave wasting of energy consumption of our country. In the past, as the development of coal production was guided by the thinking that emphasis should be given to stoping resulting in little attention to dressing and neglect of consumer needs, consequently the development of coal dressing has been slow. For 30 years, the level of coal washing has remained the same as that of the early period of the founding of the People's Republic, nor has there been any basic change in product composition. The percentage of washing of raw coal has been fluctuating around 18 percent, whereas coal washing has almost been fully adopted in England, West Germany, Japan and elsewhere.

At present, our country is the only country which consumes mainly raw coal. Every year more than 80 percent of raw coal is consumed without dressing. This is a cause of the poor effects of energy consumption in all sectors of the national economy. The first poor effect is the high ash content of coal. The second poor effect is unitary variety of coal, making it difficult to supply the right kind of coal for each different type of technological equipment and causing more coal consumption. The third poor effect is poor utilization of highgrade coal, which is a waste of natural resource. For example, 40 million tons of coal are consumed by the production of chemical fertilizers in the country as a whole. The best effect can be achieved, if medium-sized pieces of anthracite are used, but 80 percent of the coal supplied are small pieces of coal and coal dust which has not been dressed. For this reason, roughly 5 million more than of coal are consumed every year. Consumption of coal by electricity generation stations amounts to 110 million tons annually, and at present raw coal is supplied by the overwhelming majority with a high content of coal lumps and stones, causing greater wear and tear on the equipment and reducing electricity generation. Besides, smashing treatment has to be provided at the generation plant. Six hundred kilowatt-hours more of coal is needed by coal grinding alone, consuming a further 300,000-odd tons of coal. In the coking of coal, of the coal allotted nationally to the coking plants only 100 million tons are washed annually, and another 100 million tons or so is burned to provide power. This indicates that one of the important reasons for the high consumption of energy can be explained by the low level of dressing, and poor utilization of thermal energy. Therefore, in order to reduce energy consumption and enhance the utilization rate of energy, it is necessary to develop coal dressing, and reform the product composition of the coal industry.

The Development of Coal Processing Is an Effective Measure for Saving Energy

Coal accounts for over 70 percent of the energy composition of our country. Therefore, coal plays an important role in saving energy. The development of coal dressing and the rational utilization of coal resources are effective approaches for saving energy.

By developing coal washing and dressing, ash content, sulphur and water content as well as other impurities of coal can be reduced. The classification of different-size lumps and qualities for allocation to different consumption departments will produce marked results in saving energy for the society as a whole.

/1. Coal washing and dressing can effectively raise the quality of coal and help to reduce coal consumption of the departments utilizing the coal./ Raising the quality of coal produces marked results in reducing coal consumption of the departments using the coal. For example, the metallurgical industry consumes 70 million tons of coal annually. As a result of the poor quality of the coal with high ash content, wasted energy consumption amounts to about 20 percent. If high-grade coal is washed with the result of reducing ash content by 1 percent, the ratio between coking coal used and pig iron produced would be reduced by 2.6 percent and the production of pig iron would be increased by 4 percent. Consequently, 2 million tons of washed high-grade coal would be saved.

/2. Coal washing and dressing can make the coal industry change from unitary production to diversified production to suit the various needs of the economic departments and to utilize the energy resources rationally./ With processing, coal can be classified into more varieties to be supplied respectively to various users and be consumer more rationally. This will greatly enhance the efficiency of burning. Coal in lumps and pellets to be used by locomotives on the railway and gas generating in the chemical engineering industry can make energy savings of approximately 15 to 20 percent. Powdered coal for use in electricity generation and civilian consumption can make energy savings of 3 to 5 percent. Now mostly raw coal is being supplied to railway locomotives, causing 18 percent of energy wastage. With washing, coal in lumps can be supplied. This will reduce the loss through coal dust flight from 14 percent to 7 percent, and 1.4 million tons of coal will be saved annually.

/3. Coal washing and dressing can expand mining, make use of coal of low calorific value and comprehensively utilize energy resources./ At present, as a result of insufficient dressing capacity above ground, stoping of thin layers of coal and coal of low calorific value is proving to be impossible. Consequently, part of the coal resources is being lost. The increase of washing and dressing capacity will correspondingly enlarge the scope of mining and increase coal production. Furthermore, it can comprehensively utilize coal of low calorific value and raise the utilization rate of resources.

/4. Coal washing and dressing facilitate the discarding and utilization of nearby waste rock, saving transport and power consumption./ Raw coal has a higher ash and waste rock content. If 300 million tons of raw coal are hauled on the railways annually, 15 percent of it is waste rock. This correspondingly increases coal consumption by 1.7 million tons of coal. Enterprises consuming coal have to haul away the waste rock in trucks to discard it once it has been picked out. This again consumes a large amount of energy. With coal washing and dressing, the waste rock can be utilized nearby. This not only saves energy, but also saves much transportation.

The development of coal washing and dressing also facilitate the overall execution of the guideline of increasing income and decreasing expenditure in the various links of coal production, transportation, distribution, and utilization as well as the laying of a good foundation of saving energy for society as a whole. In comparison with the technological transformation to be undertaken by the coal consuming departments concerned, the expansion of coal washing and dressing have the advantage of less investment, shorter cycle, and better economic results.

If 90 percent of the coal distributed by unified allocation can be washed and dressed, transportation expenses can be reduced by 5 percent, value of output increased by 20 percent, profits increased by $900 million, and coal consumption reduced by 10 percent. All these, put together, would amount to a net increase of 30 million tons of raw coal.

Washing and dressing comprise the primary processing of coal. If advanced processing is undertaken, for example gasification and liquefaction of coal, the chemical engineering of coal, and the development of integrated use of coal, will further enhance the extent of utilization of coal. In this way, the coal industry will not only provide high quality energy, but also produce many industrial products and create more value. If the value of coke oil is taken as 1, after being turned into plastics the value of the output would be increased to 10, to 40 after being processed and turned into dye stuffs, and to 80 after being turned into pharmaceutical products. Obviously, once having been processed, coal will rise greatly in output value.

Readjust the Policies and Expedite the Development of the Coal-Processing Industry

Within the development of modern construction, the demand for coal in industrial consumption will greatly increase, and more varieties and better quality of coal will also be demanded. In this regard, we make the following suggestions:

/1. Integrate the coal-processing industry as an important part of the coal industry./ The development of the coal-processing industry is an important part of the modernization of our industry. Over the years, as a result of the neglect of this industry in our guiding thinking, it is not only the coal-processing industry alone which has been hindered, but the national economy as a whole has been unfavorably influenced. In this respect, experiences and lessons must be summed up, and changes must be made in our thinking as well as in our policies. The development of coal-processing must be regarded as a major measure as significant as directly increasing coal output, and should be grasped as an important link in coal production. Coal industry departments should not only develop coal production, but also coal processing; not only production and marketing of coal, but even more processing of coal. Great efforts must be devoted to the development of the coal washing and dressing industry as well as other processing industries. The same goes for the development of gasification, liquefaction, coal-modeling, and coal chemical engineering in order to gradually change the composition of the coal industry, to provide the various departments of the national economy with good quality, diverse variety, and highly efficient coal, and to lead the coal industry into the channel of rational utilization of resources and economic efficiency.

/2. Accelerate the construction of coal-processing plants in order to expand the capacity of processing./ At present, coal mining and washing are in disproportion, and the processing industry is lagging behind considerably. It is necessary to list the changing of the backward state of coal washing and dressing as an important task of readjustment and to form a coal processing industry production system as soon as possible. For coking coal which is a scarce resource with high economic value and a rich coal, full scope must be given to washing. For gas coal and lean coal, washing must be practiced according to need. For power coal and anthracite, sieving should be practiced in principle. Coal for export should be fully washed and dressed. We must strive to put an end to the history of direct sales of raw coal in our country.

/3. Rational economic policy must be adopted to stimulate the development of coal processing industry./ At present, the plan targets, the method of calculation as well as the policy of pricing are unfavorable to the development of coal washing and dressing. The production of coal mines as well as the sale of products is measured mainly in terms of raw coal. In addition, pricing of the different varieties of coal is irrational. Many coal mines give top priority to the fulfillment of the plan target of raw coal, and are reluctant to develop coal processing. Therefore, to develop the processing of coal, a change must be brought about in regard to paying attention to the quality of raw coal to the neglect of varieties and quality as well as methods and policy for economic efficiency. For the coal enterprises, quality should be assessed in terms of varieties of coal. The calculation in terms of raw coal should be replaced by calculation in terms of commodity coal and standardized coal. Achievements must be made in regard to the tallying of production and sales, supply to fixed points, the execution of pricing according to quality, the formulation of rational prices for different varieties of coal so that better prices are paid for better quality, direct sales of raw coal are limited by economic policy, and the development of processing of coal is encouraged and supported. In the meantime, the advantageous conditions of the coal mines must be made use of in cooperation and joint-management with the local governments to develop urban gas supply and gas for industrial uses.

/4. Strengthen scientific research work and exert great efforts to developing the technology for integrated use of coal./ The strengthening of research on coal washing is a must. The existing coal-washing plants must be transformed by adopting new techniques, new technologies, and new equipment in order to develop and construct technological systems for diversification of products and to head for the development of large-scale production, high efficiency, and simplification. Cooperation with foreign countries must be strengthened; the experimentation and research in gasification and liquefaction of coal as well as the chemical engineering of coal must be accelerated, and the technique of making use of coal must be enhanced. All this should be done to create conditions for the development of the coal-processing industry.

CSO: 4006/265

HANZHONG COAL MINES RESUME OPERATIONS AFTER FLOODS

Xi'an SHAANXI RIBAO in Chinese 12 Dec 81 p 2

[Article: "Hanzhong Prefecture Coal Mines Resume Full Production"]

[Text] In mid-August [1981], the coal mines of Hanzhong Prefecture were threatened with inundation by floods of extraordinary severity and by landslides on five occasions, and surface installations and equipment were virtually all destroyed. One shaft was completely plugged by mud and rock, and the underground equipment, tunnels and work faces were inundated by seepage. The entire mine was clogged with sediment and it was necessary to suspend production; direct losses totaled more than 1.8 million yuan.

To deal with this unusual disaster, the local mines' party organizations combined intensified ideological-political work with solution of the specific problem and rapidly organized the provision of food, clothing and housing to 15 employee households affected by the disaster, sent members to visit 35 affected households in the countryside, provided suitable emergency aid and comfort, and maintained order so that the relief work could proceed smoothly.

All mine employees took the attitude of owners in the flood recovery work and participated actively in saving state property without thought of compensation. Equipment repair shop personnel performed 364 voluntary jobs amounting to 1,890 working hours. More than 300 pieces of equipment were recovered from flood waters or debris, and the shop repaired more than 90 electric motors, saving more than 4,000 yuan in repair costs. At shaft No 2, were a bridge was destroyed and all surface equipment was washed away, tunneling was formally begun on 7 September. At shaft No 1, which was stopped up by mud and rock, the men used shovels and carts to cart away more than 19,000 cubic meters of debris, opened the shaft and laid 1,500 meters of large-size water piping, installed 6 high-head pumps, and accomplished the plan for removal of seepage water from the shaft three days ahead of schedule, removing more than 50,000 cubic meters of seepage water and safeguarding the mine.

Shaft No 2 formally resumed coal production on 11 November and Shaft No 1 on 20 November. This heavily disaster-stricken operation has now completely resumed production, and has already produced a total of 1,440 tons of raw coal.

8480
CSO: 4006/277

HYDROPOWER, COAL, PETROLEUM, THERMOELECTRIC

INCREASED COAL PRODUCTION REPORTED IN COUNTY IN HUBEI

Wuhan HUBEI RIBAO in Chinese 26 Nov 81 p 2

[Article by Daye County Industrial-Transportation Staff Office: "Coal Production in Daye County Above 200,000-ton Level for the First Time"]

[Text] Since the introduction of the system of economic responsibility, all 16 coal mines in Daye County have increased their production as well as their income, and for the first time, their output was more than 200,000 tons. The annual production plan was fulfilled 2 months ahead of schedule.

Daye has rich coal resources. However, because of "eating from the same pot" in production management among the coal mines run by the county, communes and production brigades, the annual output for many years remained at a level of approximately 170,000 tons, and the economic result was poor. Since the beginning of this year, the coal mines, noting the many different types of work involved, the complex and arduous nature, and the great need for safety measures in underground work, have separately introduced the systems of linking remunerations and bonuses with output and consumption, piecework wages and other forms of economic responsibility among different mines. The productive forces are now liberated and the economic result has been improved. After introducing the system of linking remuneration with planned output and through good coordination of work on and below the ground surface, the coal output of the Dongfeng state-run coal mine in the first 10 months of this year was increased by 37 percent, the production cost was reduced by 14.3 percent, and the workers' income was raised by 16 percent, compared with the same period last year. The Hekou Commune coal mine, which adopted the responsibility system of linking bonuses with consumption, also greatly reduced its investment in production, and the production cost for each ton of coal this year was reduced by more than 50 percent below last year's. From January to October, the mine had an output value of more than 650,000 yuan and made a profit of 190,000 yuan at a profit rate of more than 25 percent. According to statistics by the department concerned, by the end of October, the county produced 234,000 tons of coal, or 5 percent above the annual production plan, and an increase of 21 percent over the same period last year. For the first time, more than 10,000 tons were handed over to the province to be transferred to other places.

9411
CSO: 4006/189

DAQING OIL PIPELINE OVERFULFILLS QUOTA

Shengyang LIAONING RIBAO in Chinese 6 Jan 82 p 2

[Article by Ding Hui [0002 8748]: "Northeast Oil Pipeline Management Bureau Begins the Year With High Production"]

[Text] With a high spirit of responsibility and having overfulfilled the 1981 assignment quota on underground pipeline oil transportation, staff and workers of the Northeast Oil Pipeline Management Bureau stayed on their posts and worked around the clock during the new year holidays and delivered 3,300 tons more oil in the first 3 days of 1982 than the same period last year and insured a great beginning for Daqing oilfield in 1982.

The delivery of Daqing crude oil is mainly handled by the Northeast Oil Pipeline Management Bureau and Daqing produces 50 percent of China's crude oil, this oil is delivered to various places primarily through pipelines. In 1981, the bureau overfulfilled the oil delivery quota by 800,000 tons and played a major role in insuring a steady and high yield of Daqing oil, easing the demand on railroad transportation, speeding up the oil supply to various large refineries in the northeast region and the development of consumer chemical enterprises and meeting the demands of industrial and agriculture production and military and civilian needs.

In the oil delivery process, a great amount of electric power is consumed to pressurize and heat the crude oil in order to maintain unimpeded flow through the pipelines, consequently the bureau has become a large electric power consumer of the northeastern region. In an effort to conserve energy and increase production, the bureau mobilized the masses and carried out 17 major technological improvements, including wax removal from the pipelines, and conserved 30,000 tons of crude oil and more than 26 million kilowatt-hours of electricity in 1981.

9698
CSO: 4013/3

SHANXI NOW PRODUCES ONE-FIFTH OF NATION'S RAW COAL

Taiyuan SHANXI RIBAO in Chinese 15 Jan 82 p 1

[Text] In the past 5 years, the average raw coal output has increased more than 10 million tons each year in Shanxi Province. In 1981, output reached more than 130 million tons, or one-fifth of the nation's total raw coal production.

Last year's raw coal production in Shanxi was 52.8 million tons more than the figure of 77.2 million tons produced in 1976.

Shanxi's raw coal output has increased every year since 1977, reaching 108.94 million tons in 1979. Since then, this basic figure has grown every year. In increasing coal production, Shanxi brought the initiative of the state, region and commune into play, with large, medium and small mines all making a higher contribution. In 1981, the coal output from State-run mines in Shanxi increased by more than 17 million tons and output from mines run by the province, prefectures, counties and communes increased by more than 36 million tons compared to 1976 figures. Great strides have been made in coal mines operated by rural communes since the Third Party Central Committee and in the last 3 years commune coal mine yearly output has grown by more than 20 million tons. Today, about 50 percent of Shanxi's total coal output comes from state-run mines, 20 percent from those under local governments, and 30 percent from communes. The majority of local and commune mines are medium- and small-scale operations.

The increase in production from the State, provincial and local coal mines in recent years is not so much because new mines have been sunk (there are some new large-scale mines under construction, but not yet in production), but rather because original mines have been extended and improved and better technology has been introduced. The policy to readjust, restructure, reorganize and upgrade has been implemented to further exploit the potential of old mines. In the last 5 years two new State-run mines have been constructed and put into production with a total capacity of 1.8 million tons. The increased capacity from improvement and extension is 4.8 million tons. Fifty-nine work faces throughout the province now have advanced, fully automated extraction equipment and most of the mines are now automated to a fairly high degree.

8846
CSO: 4006/295

HYDROPOWER, COAL, PETROLEUM, THERMOELECTRIC

SHIGEJIE REGISTERS BIG GAINS IN COAL EXTRACTION

Taiyuan SHANXI RIBAO in Chinese 15 Jan 82 p 1

[Text] Workers of the Shigejie coal mine of the Luan Bureau of Mines took Daqing's basic experience seriously. They supported the principle that political thought leads the way. By struggling hard, working diligently, and making efforts in strengthening scientific management of the enterprise, they again obtained new records in 1981.

Raw coal production was ahead of the State Plan schedule by 40 days, and tunnelling by 62 days. The total raw coal production reached 1.11 million tons, 1.4 million tons more than called for in the State Plan. Tunnelling was 1,341 meters more than that of the State Plan. Minor and major injuries decreased 20 percent and 50 percent respectively compared to 1980. Fatalities per million tons of coal produced were reduced to 0.4 percent. The Shigejie coal mine has been rated a class B coal mine for safe production.

Last year, the mine reorganized labor and labor discipline put more than ten miners, who originally had worked underground but had returned to the surface in 1978, back to first line production. The 160 newly employed workers were sent to the drift group. Thus, first line production now has its required number of workers; the second line now has a qualified backbone and organization has been streamlined. The overall mining efficiency is 2.287 tons per person, keeping it at the forefront of state-run mines.

Consumption of materials was reduced significantly. Consumption of wood in shafts was reduced to 43 m^3 per 10,000 tons of coal produced, 42.67 percent lower than that called for in the state plan. Use of explosives was 44.44 percent less than called for in the state plan. Thirty-six percent fewer blasting caps were used. Not one metal beam was lost in the entire year. The cost of a ton of coal was reduced to 13.96 yuan.

The mine's four extraction units employ mechanized mining with the degree of extraction mechanization approaching 100 percent. The new mechanized mining equipment purchased abroad last year passed the test on mining bottom layer coal. Monthly raw coal production broke the 40,000-ton mark, reaching the standard stipulated by the Ministry of Coal Industry.

8846
CSO: 4006/295

NEW YEAR SEES GREATLY INCREASED COAL OUTPUT IN SHANXI

Taiyuan SHANXI RIBAO in Chinese 13 Jan 82 p 1

[Text] Good news from the fourteen state-operated coal mines in Shanxi Province has been heard frequently since the beginning of the year. More than 2.07 million tons of raw coal were produced for our country from 1-10 January, a 17 percent increase in the average daily production over the same period last year. Coal production increased more than 168,000 tons in this period.

Datong, Yangquan, Xishan and the other state-run coal mines are the backbone of Shanxi's coal industry. Last year's 67.6 million tons total raw coal production exceeded the State Plan. This year, the production assigned by the state is 7.69 percent higher than that of last year's. To assure the completion of this important assignment, all coal mines--beginning with the new year--have been studying the basic experience of Daqing. They are involved in activities such as selecting models and standard bearers. A large number of staff and workers are following the example of miner Fu Changwang. By studying and catching up with the advanced, they were able to steadily increase the output of raw coal. Leading cadres at the bureau and mine levels work closely with the miners in fact-finding studies and production supervision, laboring right along with the workers and accelerating production. After taking steps to increase productivity, and concentrating on the weak links, the Fenxi Mining Bureau, behind in production last year, has now caught up. Raw coal production in the first third of January 1982 was 4 percent higher than that in the same period of last year. This achievement exceeded the State Plan. Production at the Huoxian Mining Bureau had been relatively low, but the output of raw coal has greatly increased since the beginning of 1982 and has fulfilled the State Plan.

8846
CSO: 4006/295

NEW SHANDONG COAL PIER ACCELERATES EXPORTS

SK180833 Jinan Shandong Provincial Service in Mandarin 2300 GMT 17 Feb 82

[Text] According to DAZHONG RIBAO, construction of the principal part of China's large deepwater coal transportation wharf at Shijiu Port officially began recently. Facing the Huang Hai, Shijiu Port is located in Shijiusuo town in Rizhaoi County where sea water is deep and suitable for building a large deepwater port. The first phase of the construction consists of two berths. One is of the 100,000-ton class, and the other, 25,000. The wharf is designed to export 15 million tons of coal annually. Its construction is extremely important in expanding coal exports, developing water transportation and promoting local industrial and agricultural production.

Shijiu Port is financed by loans from the Japanese Government and designed and constructed by our country. Preparations for the construction began in June 1980.

In order to speed up the construction, Shijiu Port construction headquarters held an oath-taking rally on 17 February. Attending the rally were leading comrades including Tao Qi, vice minister of communications; and Song Yimin, vice governor of Shandong.

CSO: 4013/18

SHANDONG MEETING OF ADVANCED COAL PRODUCTION UNITS

SK171040 Jinan Shandong Provincial Service in Mandarin 2300 GMT 16 Feb 82

[Excerpts] According to our reporters, the Shandong provincial meeting of units and individuals advanced in coal production opened ceremoniously in Jinan on the afternoon of 16 February. The meeting will study the circular prepared by the leading party group of the State Economic Commission and transmitted by the central authorities on emulating Daqing in industry, sum up 1981 work, work out 1982 tasks, exchange experiences, commend the advanced and mobilize workers on the province's coal production front to whip up an upsurge in the socialist emulation drive in which they will emulate, learn from, catch up with, help and in turn surpass the advanced and each other.

Leading comrade of the Provincial CCP Committee and government including Su Yiran, Wang Jinshan and Liu Peng attended the meeting. Wang Jinshan, secretary of the Provincial CCP Committee, spoke.

In his speech, Comrade Wang Jinshan urged staff members and workers on the province's coal production front to understand the importance of coal in the national economy, be fully conscientious of their heavy tasks, enhance their enthusiasm, take the interest of the whole into account and strive to produce more and better coal to support the four modernizations program.

Comrade Wang Jinshan said: Premier Zhao Ziyang pointed out in his report delibered at the fourth session of the Fifth NPC that in 1982 we should develop the national economy a little faster than in 1981, ensure a 4 percent increase in agricultural and industrial production and strive for a 5 percent increase. The Provincial CCP Committee and government have urged us to ensure a 5 percent increase and strive for 6 percent. The fulfillment of these targets hinges on energy. Coal accounts for over 80 percent of the province's energy consumption. An important part of the energy industry, coal plays a crucial role in the national economy. It is an important material foundation for developing agricultural and industrial projection. All the fronts are urgently in need of coal to accelerate economic development and are eagerly expecting the coal industry to satisfy their needs.

Comrade Wang Jinshan said: The province's coal production plan for 1982 requires we produce 40.2 million tons of coal. Moreover, we should strive to produce an additional 1 to 1.5 million tons of coal in line with the demands of ensuring a 5 percent increase and striving for 6 percent. This is a very arduous task.

CSO: 4013/18

HYDROPOWER, COAL, PETROLEUM, THERMOELECTRIC

HARD WORK PAYS OFF IN EXPLOITING GUANGDONG'S COAL RESERVES

Guangzhou NANFANG RIBAO in Chinese 12 Dec 81 p 2

[Article by Tang Guangli [3282 0342 4409]: "Old Man Chen Makes Great Contributions to Developing Guangdong's Coal Industry"]

[Text] Comrade Chen Yu [7115 6735] is commonly called "old man Chen." This is not just because he has joined the revolution for a long time, more importantly, it is his loyalty to the revolutionary endeavor of the Party and the people and his enthusiastic revolutionary spirit. Comrades often say, old man Chen, old man Chen, his revolutionary spirit never grows old! Comrade Chen Yu was transferred from the Ministry of Coal Industry in 1957 to serve as governor of Guangdong Province and Secretary of the Guangdong Provincial Committee of the Chinese Communist Party. At the time, when the provincial committee assigned duties, old man Chen wanted to take charge of industry. Old man Chen saw that Guangdong's industrial foundation was poor, its technology was backward, there was a serious deficiency of fuel and raw materials. In particular, the food of industry--coal, was pitifully scarce. This greatly affected the development of work in Guangdong. Old man Chen wanted wholeheartedly to build up Guangdong's industry. On March 22, 1958, old man Chen called me and told me that in organization, it was decided that I would be in charge of the department of heavy industry. At the time, the department of heavy industry had many duties including machinery, petroleum, chemical engineering and coal. But he pointed out to me clearly: The duties of the department of heavy industry are many, but coal must be grasped well first. Coal is the food of industry. If there is coal, industry can be built up well. Old man Chen wanted me to report to duty within a certain time limit to study the question of building up coal production as soon as possible.

At the time, the higher authorities placed a lot of emphasis on grasping machinery and chemical industry. Why did old man Chen want me to grasp coal first? At the beginning, I did not understand this well. "Guangdong does not have any coal" was the unanimous view of the people before and after liberation. Guangdong's coal industry could not catch up, and the coal used relied mainly on imports from other provinces and foreign countries. In 1949, Guangdong produced only 79,000 tons of coal. By 1957, production had reached 860,000 tons. But in that year, consumption of industrial coal in Guangdong was 1.89 million tons, including 1.02 million tons imported from other provinces. At the time, residents in Guangzhou, Foshan, Shaoguan cities all burned firewood for cooking. I have worked in Guangdong for many years and have become accustomed to this situation. But old man Chen believed this situation must be changed immediately. He said: Such a severe shortage of industrial coal requires importing over 1 million tons of coal each year, and the transportation cost alone amounts to several dozen million yuan, adding to the burden of railroad transportation and affecting the transportation of other materials. As industry develops, the amount of coal consumption will greatly increase, and the difficulties in our province and the state will become even greater. Also, we do not know how much timber will be burned each year by Guangdong's urban population of several million. This is unfavorable to protecting forest resources and it is a great loss to national construction. We must be determined to organize forces to develop coal in Guangdong and to solve the problem locally.

To develop Guangdong's coal industry, old man Chen went everywhere to propagandize the importance of our province's coal industry and spoke about it at every meeting he attended. But at the time, many people were deeply influenced by the "theory that Guangdong does not have coal" and they believed although coal is important, but Guangdong does not have any coal to be exploited. To answer this question, old man Chen, based on his many years of experience in grasping the work to develop coal, believed that before liberation, the geological resources of coal in Guangdong were not fully prospected, therefore, forces must be organized to carry out surveys and studies. He instructed the geological departments to gather prospecting forces to tightly grasp the work of carrying out geological prospecting in some of the areas which have coal resources on the one hand, and on the other hand, he organized cadres and technicians to go deeply into some localities that have small coal mines to understand the history and the present situation of coal mining. He went to every place and to all the sites himself. He asked the old workers and old farmers who had mined coal in the past to talk, he understood the situation of mining coal resources, and he patiently listened to their opinions. After a period of work, he grasped some reliable data. Old man Chen said: "Guangdong does have coal which can be exploited! Although the coal seams are thin and the reserves are not large and although there are either water or fire underground and mining would be difficult, but, it is also difficult to import coal from other places. Our province has this resource, why not utilize it?" Old man Chen calculated the figures for us, he said: "These small coal mines in our province of Guangdong will cost more to mine, but, mining locally will reduce transportation costs. Shipping one ton of coal from the north to the south costs 14 yuan. One railroad car holds 50 tons. How much would it cost to ship a million tons of coal from other provinces? How many of the nation's cars would be needed? Whether we start out from the overall situation or from the local situation, we must firmly build up the coal industry in Guangdong and extract coal locally as much as possible." His point was fresh and clear, his argument was reliable, and the provincial committee and the party committees at every level all decided to develop the coal industry and the enthusiasm of comrades to build the coal industry well was mobilized.

Old man Chen did not just talk. He acted personally. To solve the series of problems in prospecting for coal fields and construction, he wrote letters and telephoned the Central Ministry of Coal Industry personally and contacted every large coal mine throughout the nation personally and asked them to provide massive support. After old man Chen went to ask for help, the Central Ministry of Coal and fraternal provinces transferred nearly 200 managerial cadres in coal mining and three geological prospecting teams of over 500 persons, over 100 coal mine designers, pit construction workers of nearly 1,000 and a large amount of equipment to Guangdong in 1958 and 1959. They served as the backbone force. The team to build the coal mines quickly enlarged. Starting from 1958, Guangdong began building mechanized coal pits. In that year, movements that combined specialized teams and the broad masses were launched to locate and to report coal mines. Coal was discovered in over 70 counties throughout the province (including the suburbs of Guangzhou City). Permanent workers of the coal industry increased from over 4,000 to more than 40,000. That year's production of coal reached over 2.5 million tons, a twofold increase over 1957.

Guangdong's coal industry rapidly developed, and problems in the transportation of coal quickly emerged. Old man Chen and leading cadres such as Liu Tianfu [0491 3944 1133] of the provincial committee personally grasped the building and rebuilding of special railroads and highways of the mining areas of Honggong, Nanling, Meitian, and Siwangzhang. Under the active support of the personal involvement of old man Chen and other leading comrades of the provincial committee and by organizing every related department, the whole province built or rebuilt over 200 kilometers of special railroads for coal mining. Effective measures were also taken to make the Xiaobeijiang, Dongjiang and Hanjiang navigable. Roads in the mining regions were repaired. The shallow-draft coal transport vessel "Unity and Victory" was designed, organized and built. Large numbers of motor vehicles were mobilized and the ability to transport coal was greatly improved.

Construction of the coal mines was mostly carried out in the mountain regions. Coal production was all underground work. The life of cadres and workers was relatively harsh, and there were more accidents in production. Old man Chen cared a lot about the life, the benefits and production safety of the coal workers. He and other leading comrades of the provincial committee organized responsible comrades of the commercial, labor and food grains departments to conduct surveys and studies at the frontline of coal production and experienced the life of the coal workers personally. After going to the mining areas personally and especially after visiting and surveying the underground pits, the responsible comrades of these departments saw with their own eyes the heavy work of the coal miners under extremely difficult conditions, and they personally experienced the harsh life in the coal pits and coal mining work. They deeply felt that hearing about it a hundred times was not as good as seeing it once. The life of the coal workers was indeed difficult and labor intensity was high. The problems should be rationally solved. Thus, they quickly established standards and quotas to supply food grains, edible oil, supplementary foods, soap and work clothes for the workers in coal mines quickly at the time when the nation was in a relatively difficult condition and decided on the standards for unified wages. This greatly encouraged the cadres and the workers, and this served greatly in assuring the development of building up production of the coal industry in Guangdong.

Old man Chen paid a lot of attention to production safety in the coal mines. He strictly demanded "safety first." "Only when there is safety can production be done well." When an accident in the coal mines occurred, he would always conscientiously investigate the cause, establish safety precautions well, and investigate those who failed to carry out their duties. Sometimes he went personally to the site of the accident to study and handle the situation, and he organized forces to rescue wounded workers and property of the state and he rapidly organized and restored production.

Old man Chen paid a lot of attention to engineering technicians and he respected and relied upon them and old workers to solve actual problems. He did not abandon a coal mine lightly. The Manling Coal Mine had suffered from a lot of flooding and fires. The coal seams had enlarged and extracting was difficult. We had considered closing it down and abandoning it many times. But old man Chen said: "It is not easy to open a mine, and Nanling is the only bituminous coal mine in Guangdong, it cannot be closed down and abandoned at will." Old man Chen overcame difficulties and continued to develop this mine so that exploitation of this mine would continue. He visited this mining region many times to hold discussion meetings with technical personnel and old workers, studied and solved a series of practical problems and safety measures, and finally prevented this mine from being closed down and abandoned. Now, this mine produces a stable annual yield of above 400,000 tons.

Old man Chen placed a lot of emphasis on conserving the use of coal. He asked mine workers to lead in conserving the use of coal and to pay attention to retrieving pit props. He went to the factories to inspect the work and explained the reasons for conserving the use of coal to the cadres and workers again and again. In 1964, old man Chen went to the Guangzhou Nitrogenous Fertilizer Plant to inspect the work. He saw that producing chemical fertilizers required the use of coke and lump coal. He felt that it was a pity. He said: "Is it possible to use Guangdong's powdered anthracite to replace lump coal in producing chemical fertilizers and free coke for smelting iron and steel?" The provincial department of the coal industry and assistant chief engineer Comrade Tan Hong [6223 4767] acted according to his request. With the massive support from the Central Ministry of Coal Industry and the cooperation of the Tangshan Coal Sciences Research Academy, briquets were made and tested at the small nitrogenous fertilizer plant and the results were successful. Later, the method was widely popularized throughout the province and the whole nation.

Under promotion by Comrade Chen Yu, Guangdong's coal industry developed relatively quickly. In 1957 when old man Chen returned to Guangdong, the annual yield was 860,000 tons. When old man Chen died in 1974, the annual yield had reached 6.26 million tons. This solved part of the shortage of ordinary industrial coal and civilian coal in our province and reduced the shipment of coal from other provinces and imported from foreign nations. In 1977, coal production in Guangdong surpassed 10 million tons, in large part due to the efforts of old man Chen!

9296
CSO: 4006/220

HYDROPOWER, COAL, PETROLEUM, THERMOELECTRIC

BRIEFS

MECHANIZED COAL EXTRACTION--As of 25 December, two of our country's fully mechanized coal extraction brigades had exceeded the 1-million-ton-mark in raw coal output. Only a handful of countries have managed to set such a production record. The two brigades are the No 4 fully mechanized brigade of the Yongdingzhuang Mine and the No 1 mechanized brigade at the Tongjialiang Mine, both under the Datong Mining Office. They used imported mechanized coal extraction equipment. In order to manage and use this advanced equipment effectively, the workers of these two brigades studied hard, mastered the equipment, and achieved the "three understandings and four abilities" in its use, namely understanding of its capabilities, operating principles and structure, and ability to operate, maintain and repair it and eliminate malfunctions; this produced a group of technically able workers. [Text] [Taiyuan SHANXI RIBAO in Chinese 31 Dec 81 p 1] 8480

HEILONGJIANG POWER PLANT--A lignite-powered 200,000-kilowatt generator was recently put into operation at the No. 2 (Fulaer) power plant, which is located on the bank of the Enjiang River in Heilongjiang Province. The power plant now has two 200,000-kilowatt generators, the first one being operated at 75 percent capacity or more. The two generators are now making great contributions to the power supplies in Daqing and Qiaihar municipalities and the western part of the province. [SK241050 Harbin Heilongjiang Provincial Service in Mandarin 1100 GMT 23 Jan 82 SK]

SHANGHAI LEVIES SURCHARGE FOR EXCESS FUEL USE--The Shanghai Municipal Economic Commission, the Municipal Planning Commission, the Municipal Bureau of Financial Affairs and the Municipal Bureau of Commodity Prices and Supplies issued a joint circular today on their decision to impose a 50 percent surcharge on the amount of fuel an enterprise uses above the assigned target. The circular said: This surcharge should not be included in the production cost. It should be paid from the enterprise's own fund or from that portion of profits that the enterprise retains for its own use. The circular pointed out: Aside from imposing a surcharge, it is also necessary to demand that any enterprise that wastes energy resources due to poor management correct the situation within a prescribed period of time. Any enterprise that consumes fuel above its target for 12 months running will be closed down for a checkup. The above-mentioned surcharge applies to any enterprise that consumes more than 600 dun of coal. 300 (?barrels) of fuel oil or 400 dun of coke per year. [Text] [OW261339 Shanghai City Service in Mandarin 1130 GMT 25 Feb 82]

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ALTERNATE ENERGY RESOURCES AND CONSERVATION

FUJIAN'S CONSERVATION EFFORT SHOWING SOLID RESULTS

Fuzhou FUJIAN RIBAO in Chinese, 4 Nov 81 p 1

[Article by Xie Guohua [6200 0948 5478] of the County Agricultural Office: "Conserve Energy Consumption, Develop Comprehensive Utilization; Jianyang County Water Turbine Pumping Project Produces Great Results"]

[Text] Jianyang County rationally utilized hydraulic resources, exerted efforts to build the water turbine pumping project to draw water for irrigation, generation of electricity, processing, energy conservation, and effectively controled grought and promoted the development of the economy of the mountain regions.

Jianyang county began building the water turbine pumping station in 1956. Up to the present, the whole county has already built 54 water turbine pumping stations and installed 145 various types of water turbine pumps (among them, 112 units of the 60 model or above), irrigating an area of over 71,000 mu. This constitutes 28.5 percent of the area irrigated by water conservancy projects throughout the province. A total of 39 water turbines has been installed with installed capacity of 3,950 kilowatts, constituting 38 percent of the total installed capacity of all power stations in farm villages. The annual output of electricity is 7.9 million kilowatt-hours. In the past, "when the water in the rivers rushed along, the farmland on the banks was arid." This situation has changed. Today, fields on both banks of the river have become high and stable yielding fields. Per mu yield has surpassed 1,000 jin. Unit yield has increased 100 to 200 percent. The Lushang Water Turbine Pumping Station of the Chengguan Commune has been built for 14 years. The more than 11,000 mu of fields of the five brigades in the irrigated region have increased production year after year. Last year, they sold more than 6.2 million jin of food grains, equivalent to the total yield of goon grains before the station was built. Comprehensive utilization of the water turbine pumps has served greatly to develop the farm village economy. Comprehensive management of the whole county's water turbine pumps last year netted a profit of over 270,000 yuan. After completion of the Yuyao and Taxia water turbine pumps of Shuiji Commune, water produced electricity. Electricity cultivated water. Water stimulated agriculture. Electricity promoted industry. The whole commune established 17 commune and brigade enterprises in rice milling, flower milling, wood sawing, paper manufacturing, oil pressing, tea manufacturing, and sugar pressing. The value of annual production reached over 1.8

million yuan. Because water turbine pumps do not use oil and electricity, in irrigation alone, they could conserve over 1,000 tons of diesel oil a year. The masses like the water turbine pumps and praise them as "high yielding pumps", "bumper harvest pumps", "money making pumps", and "lucky pumps".

Jianyang County emphasized the building of water turbine pumping projects and grasped the work as a key point in water conservancy construction. It strengthened leadership, planned well, suited measures to local circumstances, and talked about real results. Construction emphasized the development of step stations on the three major rivers of Nongyang, Nanpu and Masha. The 14 turbine pumping stations built according to plans for these rivers are producing benefits for a long period.

9296
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SIMPLE SOLAR COOKERS WELCOMED IN GANSU'S RURAL VILLAGES

Beijing TAIYANGNENG [SOLAR ENERGY] in Chinese No 4, 1981 pp 17-18

[Article by the Science Committee of Yongjing County of Gansu province: "Popularization of Solar Cooker Is an Effective Way To Solve the Energy Problem in Rural Villages"]

[Text] Yongjing County is one of the 18 arid counties in the central regions of Gansu province. In that region, the mountains are barren and tall and valleys are deep. Trees are scarce. The vegetation is very poor. Soil erosion is very serious. Although this is a place where drought occurs 9 out of every 10 years and the three materials (fuel, feed, fertilizers) are all lacking, one advantage is that the solar energy resources are very rich. The annual number of hours of sunshine is 2,500 to 2,900 hours. The total annual solar radiation is 1,450,000 kilocalories/M^2. The frostless period is 140 to 200 days. The annual amount of rainfall is about 300 millimeters. Therefore, the use of solar energy as a substitute for certain ordinary energy sources has a bright future.

But for a long period, because of a lack of firewood, a large portion of the labor force has been spent on shoveling young grass cover, digging grass roots, gathering animal excrements, and scraping up manure. In order to gather firewood and grasses, many school-age children could not go to school. Even so, on overcast days, often handles of picks, baskets for manure, window lattice, old shoes and rags were used as firewood for cooking. And bamboo mats and ends of straw mats of eaves supplied by the state as disaster relief were taken down and burned. As time passed, precious organic fertilizers were lost. Vegetation was seriously destroyed. The soil became infertile. The ecology worsened. The ability to resist disasters weakened daily, and disastrous results were brought upon agriculture, forestry and livestock production.

To solve the energy problem in farm villages of our county, the county committee mobilized the masses on the one hand to plant trees and grass on the barren mountains and in front of and behind houses and to build fuel forests, and on the other hand, actively supported our development and popularization of the solar cooker.

The solar cooker has been known for a long time, but it was only book knowledge. We referred to the books, relied on our imagination, explored and finally built one flat solar cooker with a light-gathering surface of 7 square meters in July of 1978 on a trial basis. But because the manufacturing cost was high, the results were poor, the technology was complicated, and it could not be popularized. At the beginning of 1979, we began to imitate the Gannan solar cooker. We tested, built and popularized the cookers at the same time and produced 54 units. This kind of solar cooker produced good results at the beginning, but after using them for half a month to 20 days, the wooden frame began to warp. The bottom bent upwards, and the mirrors fell off. Later, we used iron mesh as the framework and covered it on the outside with sand and cement to make a solar cooker encased in cement. The cooker thus built was subjected to over 2 months of wind, sunshine and rain, but the shape remained unchanged and the light gathering property was very good. Thus, we went to the Dazhuang Production Team of the Songshuwan Brigade to demonstrate and there we built 10 units. After testing, they were enthusiastically welcomed by the masses. They wrote letters of thanks to the party committees of the prefecture and the county and asked that the cooker be popularized throughout the brigade. The county committee conscientiously discussed the matter and immediately the local finance office appropriated funds of 10,000 yuan to assist the Songshuwan Brigade popularize it. With only 2 months' time, the whole birgade's 188 families of commune members began using solar cookers. Then, we held a field meeting there. Organized cadres from the three levels of the county, the commune and the brigade to come and observe demonstrations using the solar cooker to boil water, bake buns and cook potatoes and to let everyone see for themselves. The event was a lively class in the use of solar energy. Delegates were enthusiastic about trying one out and everyone unanimously believed that although these cookers were slightly heavy, their outer shape was stable, they were durable, the technology was simple, and their useful life was long. They would not topple when a pig bumps into them. They would not overturn when a sheep rams into them, and they were suitable for use by farm families. According to the demands of the masses, we also popularized the solar cooker at one or two brigades of the Yangta Commune and other communes in the mountain regions. And after half a year of efforts, we built a total of 2,976 solar cookers. Over 2,900 families of commune members of the 12 communes throughout the county have begun to use solar cookers, constituting 12 percent of the total number of farm families of these communes. Among the 953 families of commune members in Yangta Commune, 914 families have begun to use the solar cooker, constituting 95.9 percent of the total number of families, and Yangta Communes has become the first commune to popularize the solar cooker in the whole county.

The solar cooker we built had two separate parts, the support for the wok and the body of the cooker. The case of the cooker was made of cement. The light gathering area was generally about 1.8 square meters. According to tests performed at the end of December of 1980 and during the first ten days of June of this year, when the temperature was -1.4°C, the cooker boiled 4 jin of water in 18 minutes. When the temperature was 26.5°C, the cooker boiled 8 jin of water in 30 minutes. After one year of practice, we realized that the solar cooker has many advantages indeed. In summary, they are the following:

1. The solar cooker conserves firewood and reduces expenditure. According to surveys of the Songshuwan Brigade of Yangta Commune, the five examplary

families using solar cookers could conserve 10 jin of firewood a day. Calculating at 200 clar days a year, this amounts to conserving 2,000 jin of firewood, equivalent to 100 yuan of renminbi (calculated at 5 fen per jin of firewood). The Yangta Supply and Marketing Cooperative sold 139 tons of coal in 1979. In 1980 after popularizing the solar cooker, it sold only 97 tons, a deop of 30 percent in sales. From January to May of this year, it sold only 14.6 tons, a drop of 31.6 tons from the same period last year, or a reduction of 68 percent.

2. Solar cookers conserve the labor force and reduce household work of women. In the mountain region, a five member family uses an average of half a labor force a day and over 180 work days a year to gather firewood. In the past, cooking one meal required two hours. Now, using the solar cooker to cook a meal requires less than one hour. It saves both effort and time.

3. The solar cooker is clean and sanitary and reduces air pollution. Originally, [illegible] firewood was used, smoke filled the air when lighting the fire and bothered the nose and eyes. Now, using the solar cooker does not produce smoke nor dust and it is clean.

4. It is beneficial to popularize scientific knowledge so that the broad masses will understand the importance of learning science and using science.

5. It is beneficial to maintaining the ecological balance and reducing soil erosion. After using the solar cooker, shoveling young grass cover, digging grass roots, gathering animal manure by commune members have greatly reduced. This has protected grazing slopes and forest timber and it has conserved animal manure and increased farm house manure.

Facts prove that popularizing the solar cooker is an effective way to solve the energy problems in farm villages. People said happily: "The solar cooker is a treasure. It does not use firewood and it does not use charcoal. It can boil water, bake buns and cook, and all of the commune members have praised it." In places where it has been popularized, the solar cooker has already become a necessity in the life of the masses of commune members. Some have even used the solar cook as the "gift" and "dowry" in marriage.

Because of the many advantages of popularizing the solar cooker in our county and because of its popularity, the county committee has decided to quickly popularize it within the whole county according to the requests of the masses. This year, plans call for an initial production of 12,000 units for popularization in 537 production teams in 69 brigades in 15 communes. Then, there are plans to create conditions to produce another 12,000 units to popularize it throughout the county. At present, the county farm machinery plant and the hardware plant have already produced over 4,100 supports and have established two production points to produce cement bodies. About 120 people have participated in production and 989 models have been built. Over 3,000 cement bodies have already been produced.

The more than 2,000 units manufactured last year (with a light gathering surface of 1.8 square meters) cost 66 yuan each to build. The unit cost of those manufactured this year (with a light gathering surface of 2 square meters) has dropped to 50 yuan. The shape of the newly produced solar cookers is more beautiful and the quality has improved. In the future, we still must summarize experience and strengthen management based on popularization to establish necessary systems and supply spare parts that easily break in time so that the popularization of the solar cooker in our county can be done even quicker and better.

9296
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ALTERNATE ENERGY RESOURCES AND CONSERVATION

NEW STUDIES FOCUS ON PRODUCING METHANE FROM INDUSTRIAL WASTES

Chongqing XIN NENG YUAN [NEW ENERGY SOURCES] in Chinese Vol 3 No 6, 5 Dec 81 pp 1-7

[Article by Guo Shiying [6753 0013 5391]: "Factories Develop Methane and Open New Energy Sources -- Investigative Report by the Chengdu Methane Science Research Institute of the Ministry of Agriculture"]

[Text] Our eight-member investigative group conducted a technical investigation of over 20 factories which have developed methane in this and other provinces from 18 April to 26 May. We visited the sites, listened to the experience of the chief technical personnel, held discussion meetings with workers and conducted studies. We obtained a rather overall understanding of the problems in producing methane using wastes from cities and factories, widened our views, increased our knowledge, learned the technology and achieved the expected goals. The following is an introduction to the main points of our investigation:

I. The Major Content of Investigation

This investigation is relatively broad. According to structure, there are three kinds of fermentation pools, the circular type, the arch type and the rectangular type. There are four ways of storing methane gas, by hydraulic pressure, in pits with floating lids, in gas bags, and in separate pools and compartments. According to the depth of the pits underground, there are underground pits, ground surface pits and semi-surface pits. The raw materials for fermentation include distillers grains, tanning mud, human excrement and city sewage. The methane produced is generally used as fuel, and then for generation of electricity. Only the Rongxian Winery uses methane as fuel for motor vehicles and only the Nanyang Alcohol Plant uses methane as a chemical raw material. The problem of treating the residue was a difficult one for all localities visited. Generally, the residues are used as farm fertilizers. Only the Nanyang Alcohol Plant extracts vitamin B_{12} from the digested fluid separated from the liquid residue and uses the remaining residue as fertilizer. Shunde in Guangdong uses the sediments from fermentation to replace cattle dung to cultivate mushrooms and grow fish. It has realized good results. The different raw materials for fermentation are described below:

(I) Distiller's Lees

Of the 21 units investigated by us, four units, the Nanyang Alcohol Plant and the Rongxian, Lezhi and Zizhong wineries use distiller lees as raw material for fermentation. The techniques of fermentation are mostly the same, that used by the Nanyang Alcohol Plant is presented here for illustration:

The Nanyang Alcohol Plant is a mechanized plant using dried trumpet creeper as raw material for making wine. It produces 70 tons of alcohol and 6 tons of keytone butyl alcohol a day and releases over 300 tons of 100°C distiller's liquid. In the past, this liquid was released into the river as waste. This was not only wasteful, it also caused serious environmental pollution. The masses complained a lot and in 1964 the plant conducted a small fermentation test to produce methane using distiller's lees with the information provided by the Fermentation Industry Research Institute of the Ministry of Light Industry. As a result, the percentage of gas output was 2.5 cubic meters/ cubic meters/unit raw material/day. Small individual tests produced a percentage of 4 to 4.8 cubic meters/cubic meter/unit raw material/day, basically approaching the level in Japan. To further explore the basic data on fermentation accurately, the plant conducted three medium tests in 1965. The methane pits were 8, 22 and 250 cubic meters respectively. The results of the experiments were, in percentages of gas output, 2.38, 2.28 and 2.43 cubic meters/cubic meter/raw material/day, basically consistent with the results of the small-scale tests. On the basis of obtaining reliable data, the plant began constructing two large new pits totaling 2,000 cubic meters in July of 1966 (another two have been built since, totaling 4,000 cubic meters). They began production in March of 1967. They have been used for 14 years. They function normally and their basic output has reached the demands of the design. Their performance has been good.

1. Methane Pit

The methane pit is a hydraulic, semi-underground rectangular pit 50 meters long, 10 meters wide and 4 meters deep with a volume of 2,000 cubic meters. The inner wall of the methane pit has two layers of glued-on material and three layers of paint. After 14 years of use, the wall still resists penetration well (worth trying). The raw material is fed from the top by stationary pressure and the gas is pumped from the bottom of the pit. There are eight wooden stirring rods but because the amount of gas produced by stirring and without stirring was about the same, these rods have not been used.

2. Fermentation

(1) Fermentation is accomplished by high temperature, single-stage fermentation. The temperature of the pit is controlled at between 53 and 55°C. The temperature cannot be more than 56°C for a long period. New raw materials are cooled to about 60°C and then added to the pit. The highest temperature cannot be over 65°C and the lowest temperature cannot be lower than 55°C.

(2) The concentration of dry matter is 5 to 6 percent, and the nitrogen-carbon ratio is 1:50. Because raw materials from distilling wine are more stable than liquids, the concentration of dry matter in the liquid distiller's grains and the ratio of nitrogen and carbon do not change greatly. This is favorable to controlling the fermentation process and to improving the percentage of gas output.

(3) Adjustment of pH: The pH of the liquids released by the distillation tower is 4.3. When the new pit is opened and thoroughly cleaned, lime is added to change the pH of the distiller's lees from 4.3 to 7.5 to 7.8, then the raw material is placed in the pit. During the course of fermentation, the pH in the pit cannot be lower than 7 nor higher than 8. After normal fermentation, the pH of the additional raw materials need not be adjusted. They can be directly placed in the pit and they will not affect fermentation much.

(4) The amount of raw materials in the pit: The initial raw materials should fill 80 percent of the pit and the remaining 20 percent of space should be left for storing the gas produced. At the beginning, raw materials in the pit should be inoculated with 15 percent to 20 percent of sludge.

(5) The rate of adding raw material and the fermentation cycle: Controlling the daily amount of raw materials added into the pit is important in fermenting methane. The daily amount of raw materials is determined by the pH (or volatile acids) of the liquid material in the pit. This plant added a daily amount of raw materials generally equivalent to 10 percent of the total amount of fermenting liquid materials in the pit. Waste materials are removed first and then new raw materials are added. If too much raw materials are added, the amount of organic acids in the pit will increase dramatically and the pH will drop. When the pH drops to below 7, the methane produced during the beginning period will contain an increased amount of Co_2, and then, the rate of fermentation will slow down and this will directly affect the quality of the gas and the amount of gas produced. If too little raw materials are added, the amount of volatile acids will drop, a precursor for gasification will be absent, and the amount of gas produced will visibly drop. According to experiments conducted by the plant, the concentration of volatile acids in the pit should be between 2,600 and 3,500 ppm and it cannot exceed 3,600 ppm. Monitoring fermentation by measuring the amount of volatile acids is more complicated and generally pH measurements are used for controlling fermentation.

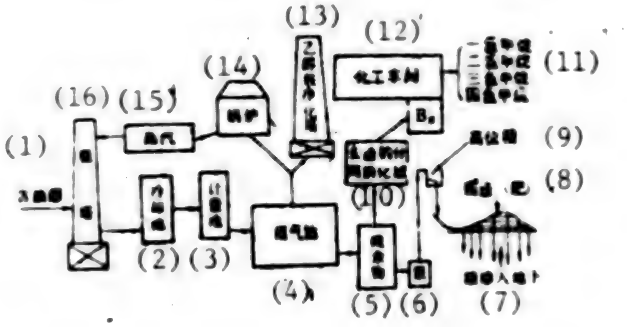
(6) Attenuating and screening bacteria: The plant believes that in methane fermentation, attenuating and screening good bacteria is a very important link when other conditions are unchanged. Many points should be selected to inoculate with sludge (bacteria). The bacteria should be concentrated, attenuated and screened, and superior bacteria should be selected for enlarged cultivation and for inoculating the pit. To increase the amount of bacteria in the newly added raw materials going into the pit, the technique of recirculating the bacteria has been used. It is a simple, easy and good method.

(7) The rate of gas output and the quality of gas: The rate of gas output by fermentation in the large pit of this plant was close to the rates of gas production in the small tests and the medium tests, averaging 2 to 2.5 cubic meters/cubic meter/unit raw material/day. The total output of methane gas was 4,000 to 6,000 cubic meters/day.

Composition of methane gas: CH_4 55 percent to 65 percent, CO_2 35 percent to 45 percent, O_2 0.42 percent to 0.6 percent, H_2S 450 to 750 milligrams/cubic meter, H_2O relative humidity 100 percent.

(Note: The rate of gas output by the Nanyang Alcohol Plant was higher than that of Ronxian in Sichuan. The Rongxian Winery used widely different raw materials and there were technical problems and leakage. Nanyang Alcohol Plant used dried trumpet creeper to ferment wine. The starch content was 63 percent to 65 percent. The content of dry matter in the liquid distiller's grains was 5 percent to 6 percent. The Rongxian Winery used rotten dried trumpet creeper. The starch content was 30 percent to 35 percent. The content of the dry matter in the distiller's lees was about 4 percent, thus the rate of production of gas was not high).

(8) Technological process (See accompanying diagram)



Key:
(1) Undecanted wine
(2) Cooling pool
(3) Measuring pool
(4) Methane pit
(5) Residues
(6) Pump
(7) Liquid seeping into the ground
(8) Residue (fertilizer)
(9) High trough
(10) Digested liquid separated from dregs
(11) Monochloromethane
Dichloromethane
Trichloromethane
Tetrachloromethane
(12) Chemical shop
(13) Ethanolamine purification tower
(14) Boiler
(15) Steam
(16) Rough distillation tower

Technological process diagram

3. Comprehensive Utilization of Methane and Residues

(1) Utilization of methane gas: The methane gas produced from 1967 to 1972 was all used as fuel for the boiler. The methane gas contained 55 percent to 65 percent of methane. The thermal value was about 5,000 kilocalories/cubic meter, therefore each cubic meter of methane gas was equivalent to 0.75 to 0.8 of a kilogram of standard coal. This could save 1,000 to 1,200 tons of coal a year.

The gas after purification contained over 95 percent methylethylene. It was sent to the chemical shop to produce many types of chemical products. The chemical shop of the plant used methane as raw material this year to produce 500 tons of dichloromethane, 300 tons of trichloromethane, and a lot of carbon tetrachloride.

In addition, methane can also be used as raw materials to produce activated carbon. The CO_2 separated from purified methane can be used to produce dry ice for freezing foods, carbonated water and foam for fire extinguishers.

Many units have used methane to generate electricity and as fuel for motor vehicles. Generating electricity with methane does not require purification. The Sichuan Agricultural Machinery Institute and the Guangzhou Energy Resources Institute studies mixed combustion of H_2S and methane. Because the amounts were small, they did not corrode the gas tank much, therefore they can be burned directly without purification. The Rongxian Winery used methane as fuel without purification and has generated 123,731 kilowatt-hours of electricity. Three motor vehicles have used methane as a substitute for gasoline and have travelled nearly 30,000 kilometers. Experiments show that methane gas containing 65 to 70 percent methane can generate 1.3 to 1.5 kilowatt-hours of electricity per cubit meter of gas. The same amount is enough for a 4-ton vehicle to run 2.5 kilometers.

(2) Utilization of fermentation residue: After the residues from fermentation have been separated, the filtered liquid can be used as raw material to extract vitamin B_{12}, and the dregs can be used as fertilizer and fuel. While producing methane gas in anaerobic fermentation, vitamin B_{12} is also produced. The waste liquid from the production of methane at the Nanyang Alcohol Plant contains 700 to 800 micrograms of B_{12} per liter. The plant used white pottery clay as the adsorbent and extracted 100 to 200 micrograms of B_{12} vitamin crystals from each ton of waste liquid from fermentation. Chemical analysis showed the pH was 7.5 after the liquid distiller's grains of the alcohol plant fermented, and the contents of immediately effective nitrogen, phosphorus and potassium were respectively 4.3 percent, 2.46 percent and 0.98 percent. The plant conducted comparative experiment with local farm house manure and methane pit fertilizers in wheat and paddy rice production. The use of methane fertilizers produced 15 percent to 21 percent more than the control crops. The dregs from fermentation at the plant has been supplied to over 200 production teams nearby (selling at 1 yuan per cubic meter) for 14 years and the results are still good.

(II) Human Excrement

The power stations of Liede in Guangzhou, Junqiao at Foshan and Shayou at Shunde and the Municipal Fertilizer Treatment Plant in Qingdao use human excrement as raw material for fermentation to produce methane gas. Junqiao uses normal temperature for fermentation, Liede uses medium temperatures and the Municipal Fertilizer Treatment Plant uses high temperatures. The Nanhui Methane Gas Science Station and Shayao only have pits of 50 cubic meters in size. They are small pits. Therefore, we have used Liede and Junqiao at Foshan as examples for the following discussion:

1. The Liede Methane Power Station

The station is a methane gas powered station using human excrements from the Dongshan Ward of Guangzhou City as raw materials for fermentation. The capacity for generation of electricity and the scale of methane production are both relatively large.

(1) Fermentation facilities and technology:

A. Methane pits: 13 pits, totaling 5,000 cubic meters.

Among them: There are 8 cylindrical surface methane pits, totaling 4,500 cubic meters.

There are 5 rectangular hydraulic methane pits, totaling 500 cubic meters.

B. Preheating pool for the raw material: A round structure is at the center of every four cylindrical pits. Upstairs is a hot excrement pump and a stirring pump operating room. Downstairs is a raw material preheating area of 90 cubic meters. Here, the supplementary raw material is heated to over 50°C and then pumped to the pit.

C. Plastic gas storage bags: 80 cubic meters x 6 = 480 cubic meters.

D. Waste material storage pool: 370 cubic meters.

E. Waste material measuring pool: 10, 20, 30, 40 cubic meters of one each.

(2) Temperature: Fermentation is realized in the group of pools for single stage medium temperature fermentation. Surplus heat from the generation of electricity is used to raise the temperature. The temperature in the pits is controlled at about 35°C.

(3) Concentration of dry substance: The concentration of dry substance in human excrement is 2 to 2.5 percent and the pH is about 9.

(4) Feeding rate and cycle of fermentation: The pit is 90 percent to 95 percent filled with preheated raw materials of 450 tons are added each day. The

rate of feeding is 10 percent. Residues are removed first and new raw material is added afterwards so that feeding and output are balanced. The fermentation cycle is 10 days.

(5) Stirring method: Stirring is done by the sewage pump for periodically stirring the fermenting liquid and this pump is also used for recirculation of bacteria to increase the amount of bacteria, to hasten the speed of fermentation and to increase the rate of gas production.

(6) Rate of gas production: It is 0.8 to 1 cubic meter/cubic meter/unit raw material/day. As the concentration of the raw material changes slightly, generally the rate of gas production fluctuates between 0.8 and 1 cubic meter/cubic meter/unit of raw material/day.

(7) Generation of electricity by methane

Methane purification tower: To remove the H_2S gas in methane gas, the methane gas is first passed through the purification tower using iron oxide as the adsorbent to remove the H_2S in the methane gas and to precipitate hydrogen gas. Because H_2S becomes SO_2 after burning, it can be mixed with water to produce sulfuric acid. Because the acid corrodes the gas tank and certain components, therefore the H_2S must be removed.

Generation of electricity: Five generators are installed. The installed capacity is 708 kilowatts capable of generating 13,600 kilowatt-hours of electricity a day. At present, 6,000 kilowatt-hours of electricity are generated and fed into the national power network.

2. The Foshan City Junqiao Methane Power Station

(1) Main facility:

A. Methane pit: The original septic tank was covered with a lid and the tank was rebuilt into a methane pit with 28 rectangular gas containers. Each compartment was 10.3 meters long, 2.4 meters wide and 1.9 meters deep. The capacity of each was 47 cubic meters. The 28 methane compartments total 1,316 cubic meters.

B. There are 4 sedimentation pits each of 47 cubic meters totaling 188 cubic meters.

C. There are 3 storage pits each of 40 cubic meters totaling 120 cubic meters.

D. Storage containers: There are two plastic containers made of polychloroethylene sheets of 0.28 millimeters thick and joined together by heat. Each container has a capacity of 120 cubic meters, totaling 240 cubic meters. Using plastic containers as storage containers is cheaper than constructing steel containers of the same capacity with a floating lid by 27 times. These plastic containers have been used for 3 years now and leaks have not occurred.

E. Generators: The station has installed two generators with an installed capacity of 90 kilowatts (one generator has an installed capacity of 50 kilowatts and the other has an installed capacity of 40 kilowatts).

(2) Fermentation:

A. Human excrement as the raw material for fermentation contains a concentration of 2 percent of dry substance and 1.7 percent of volatile solids. Because the excrement has aged (has already fermented), the pH is about 7.

B. Normal temperature fermentation: The climate in this region is subtropical. The period of relatively high temperatures usually lasts 8 to 9 months. During this period, the temperature in the pit is generally 25 to 30°C, and in winter, the temperature drops to 14°C.

C. Amount of filling and amount of feeding: The pits are filled to above 9.5 percent. Each day, the amount of raw material fed and removed from the pits is about 60 tons each. The amount of feeding of new raw material constitutes 4.5 percent of the content in the pits. The fermentation cycle is 22 days.

D. Production of gas: When the temperature in the pit is 30°C without stirring, the rate of gas production is 0.33 cubic meter/cubic meter/pit/day. The daily total output of gas is 400 cubic meters. If the contents are continually stirred, the average rate of gas production is 0.55 cubic meter/cubic meter/pit/day and the total daily output of gas is 720 cubic meters, an increase of 80 percent more than the output when the contents are not stirred. In winter during the period of lowest temperature (about 14°C), the rate of gas production is half that during summer.

E. Quality of gas: The CH_4 content is 68 percent to 72.5 percent. The content of CO_2 is 26 percent to 27 percent, and there is a lot of H_2S and CO gases. According to experiments conducted by the Energy Institute, stirring does not affect the content of the gases produced.

(3) Generation of electricity: The methane gas produced by that station is all used for generating electricity. Methane gas produced at a temperature of 40°C can generate 1.5 kilowatt-hour of electricity per cubic meter and the total thermal efficiency is 24.3 percent. Each day, 600 to 1,000 kilowatt-hours of electricity can be generated. Deducting 6 percent for the electric power consumed by the plant, the net daily yield is 94 percent.

(4) Rendering human excrement safe: The surplus heat from the use of methane to generate electricity is used to heat the raw material to be added each day so that the temperature of the new raw material is raised to 60°C and maintained for a period before the new raw material enters the pit for fermentation. This reduces the population of live larvae by 94.6 percent and the number of colon bacilli can be rendered harmless.

(5) Changes in the effectiveness of fertilization after fermentation: The content of ammoniacal nitrogen increases by 40 percent but the content of

whole nitrogen and whole potassium does not visibly change. The content of whole phosphorus visibly drops. This may be due to the presence of insoluble compounds of phosphorus in the residue while samples taken were mostly from the top layer of overflow liquid excrement which contains very little residue.

(III) Tanning Sludge

The Shanghai Hongguang Tannery uses sludge from tanning as raw material to produce methane. The plant conducted a small-scale test of producing methane by anaerobic ferementation of tanning sludge and dynamic simulation experiments, and on this basis, carried intermediate experiments of producing methane by fermentation of the sludge. The facility for the intermediate experiment was built in October 1980 and was test run for 6 months. They produced a test result of 1 cubic meter/cubic meter/unit raw material/day of gas, surpassing the expected goal (0.5 cubic meter/cubic meter/per unit raw material/day) by 100 percent.

(1) Main equipment:

A. Raw material mixing tank of 100 cubic meters, a raw material output tank of 100 cubic meters.

B. Fermentation pool: Primary fermentation tank of 50 cubic meters, secondary fermentation tank of 45 cubic meters.

C. Gas storage container of 50 cubic meters.

D. Generators: The generator had a capacity of 50 kilowatts, the motor was the S195 generator.

(2) Control conditions of the intermediate experiment:

A. In the intermediate temperature secondary fermentation utilizing surplus heat for heating, the temperature was controlled at 35°C, ±1°C.

B. The concentration of dry substance was 5 percent to 7 percent.

C. Stirring: The liquid raw material was stirred once every 8 hours for 15 minutes.

D. Amount of feed and amount of fill: The pit was 95 percent filled. New raw materials equivalent to 5 percent of the content of the pit were added each day. The fermentation cycle was 20 days.

E. The pH was 7 +0.2.

F. Attenuating bacteria and amount of inoculation: Tanning sludge contains compounds of chromiun, sulfur and chlorine which greatly surpass the allowable concentration for anaerobic ferementation. If ordinary mixed bacteria are used for inoculation, the expected results will not be achieved and fermentation will not be possible. After many experiments, the plant used bacteria screened by natural aging and attenuating in aged sludge for inoculation and this was successful.

G. Measurement of gas: Each shift recorded the reading of the flow counter at fixed intervals.

H. Chemical analysis: Chemical analysis analyzed the nature and content of the gases at different stages of fermentation of the sludge and studied the dynamics of fermentation so that corresponding measures could be taken.

(3). Results: This intermediate test lasted from November 1980 to April 1981. After 6 months of fermentation experiments in cold weather during winter, the rate of gas production surpassed the expected goals with the following results:

Rate of gas production: 1 cubic meter/cubic meter/unit raw material/day.

Daily output: 50 to 70 cubic meters.

Content of methane gas: CH_4 69 percent, CO_2 21 percent, O_2 2.4 percent, H_2 3 percent, N_2 4.6 percent.

Removal of harmful substances: The amount of solid substances was reduced by 50 percent, and viscosity of the sludge was reduced. BOD was reduced by 80 percent, COD_{cr} was reduced by 70 percent, S was reduced by 55 percent.

Generation of electricity: 0.65 cubic meters of gas produces 1 kilowatt-hour of electricity. The amount of electricity generated for a whole day was 77 to 107 kilowatt-hours. The plant consumed 32 kilowatt-hours. The net power produced was 43 to 75 kilowatt-hours.

Anaerobic fermentation of tanning sludge was successful and a new path for treating it has been opened up. After the sludge is fermented, a new energy source is created, and environmental pollution from this source will be greatly reduced. Therefore this has practical significance.

II. Several Techniques Worth Popularizing and Exploring

1. The problem of which type of methane pit should be used: Factory-operated methane pits are generally large pits (over 1,000 cubic meters). According to reports by various localities, pits should not be too large because the requirements for design, construction and materials are high. It is difficult to prevent gas leaks over large areas, and management, use and maintenance are not convenient. A small problem will force the whole operation to shut down and force production to stop. Therefore, wherever we went, everyone proposed that groups of round pits of 500 cubic meters would be best. Group pits can overcome the above shortcomings of large pits and they can assure that production does not have to be stopped during the year and the use of gas can be balanced. Round pits facilitate stirring and there are no dead corners.

Another problem worth attention is to reduce the waste of energy. While following the overall plan and suitably satisfying the requirements of the technology of fermentation, we should fully develop the topography and the concept of conservation of the design personnel, utilize potential energy as much as possible, exert efforts to realize the process of stationary pressurized automatic flow, and reduce energy consumption of the plant. These are very important in conserving energy and reducing costs.

2. The problem of preventing gas leaks: Prevention of gas leaks over a large area is a difficult problem in building pits. The Foshan Junqiao Methane Power Station uses emulsive mortar to plaster the walls. The pit is sealed in water. This has basically solved the problem of gas leaks. The concrete method is as follows:

Three layers of plaster: The first layer is a coat of 1:3 cement mortar of 5 to 8 millimeters thick. After the first layer solidifies, a second layer of emulsive mortar of 5 to 8 millimeters thick is applied, i.e., mixing white emulsion (polyacetic ethylene emulsion) of 5 percent to 10 percent the weight of the cement 10 with the 1:3 cement mortar. The white emulsion is first thinned then mixed with the cement mortar. After the second layer has solidified and dried, a third layer of emulsive cement mortar of 2 millimeters thick is applied. White emulsion of 15 percent to 20 percent the weight of the cement is diluted by adding water and then mixed with cement to become white ash for plaster. Because white emulsion promotes condensation of the cement, the mixture must be stirred as it is applied. Stirring and applying the mixture should be completed within 20 minutes.

After the emulsive mortar has thoroughly dried, two other thin and even coats of asphalt are applied. The second coat must be applied only after the first coat has dried, otherwise the asphalt will not stick to the wall of the pit and will peel off prematurely. After the above procedures have been completed, the water tank above the pit should be filled with clean water to keep the top part moist and to prevent the concrete structure from cracking, and at the same time, this also serves to prevent gas leaks.

Pits that have been sealed by the above method have been used by this station for 6 years and after clearing the pits for inspection, gas leaks have not been discovered, proving that the above method is effective.

The Nanyang Alcohol Plant in Henan uses two layers of glue and three coats of paint to treat the inner wall and the result is also good. The plant built two large methane pits of 2,000 cubic meters in 1966. This method was used to seal the pits and they have been used for 14 years without any serious gas leaks. The concrete method is as follows:

After the inside of the pit is washed and dried, a torch is used to burn the inside surface once, then an even coat of asphalt is applied. Then, a layer of fine felt is laid. After this "layer of felt and layer of asphalt" have completely dried, the above method is used (not burning by fire) to lay the second layer. When the second layer has completely dried, asphalt is evenly coated on top several times back and forth. After a few days, the pit is ready for storing materials and for fermentation. Materials can be easily obtained for this method. The cost is low and operation is simple and easy to grasp

3. The problem of whether to adjust the pH for fermentation of human excrement and liquid distiller's grains: Under ordinary conditions, the pH of human excrement is 9. The pH of liquid distiller's grains of a winery is 4.3 to 4.5 while the pH suitable for methane gas fermentation is 7 to 8 (most suitable pH is 7.3 to 7.8). Therefore, usually when using this type of raw material for fermentation, the pH must be adjusted to the most suitable range and then fed to the pit. The Qingdao City Fertilizer Treatment Plant and the Nanyang Alcohol Plant used this type of raw material for methane fermentation and only adjusted the pH of the raw material for the new pits or for old pits that had been cleaned to 7.3 to 7.8. After gas production began, the pH of all newly added raw material was not adjusted and gas production was still normal. This showed that in the system of methane fermentation, there are salts that serve a buffer function which can automatically adjust the pH. Sichuan Rongxian Winery fermented methane and added new raw materials of 140 to 150 tons a day. Each month, 18 tons of lime were used to adjust the pH. Even when the pH was not adjusted, the production of methane gas was still normal. Each month, up to a thousand yuan were saved in expenses. This should be tested and popularized.

4. The problem of stirring: If the fermenting liquid material is not stirred, frequently, three layers of substances, floating residues, clear liquid and mud will separate out because they are at different depths in the pit. In these three layers, the utilization and decomposition of raw materials, the content of organic matter and the amount of bacteria are all different. If the content is stirred, this will not only stimulate the release of methane digested by the liquid, it will also mix the liquid material and temperature evenly, increase the chance of contact between organic matter and bacteria, hasten liquifaction of the raw material, hasten the gasification process, and serve importantly to shorten the cycle of fermentation and increase the output. This has already been proven by many people. But the Nanyang Alcohol Plant used liquid distiller's grains as raw material and it conducted many small tests of stirring and not stirring. The results were basically the same. Therefore, the fermenting material in the large pits of the plant was not stirred. Whether fermentation of distiller's grains to produce methane requires stirring or not can be further explored. Is this a special character of the conflict or is it a general characteristic? Is it because a certain design of the flow process has served the function of stirring it or is it caused by human error? If this is so, investment can be saved, the production links can be lessened, the cost can be lowered, and this would be a major improvement in the fermentation of methane.

5. The problem of attenuating and screening bacteria: Gathering, selecting suitable sewage bacteria for concentrated cultivation, attenuating and screening are an important task in methane fermentation. Each locality has its own profound experience: "The bacteria for fermenting methane is equivalent to

"distillers yeast" in making wine. The quality of the distiller's yeast directly affects the output and quality of wine. Poor "distiller's yeast" will surely produce poor wine. Therefore, to obtain methane with a strong decomposition, a high output of gas and good quality gas, mixed bacteria should be used at many inoculating points and they should be tamed and cultivated according to the controlling conditions required by the design to select superior bacteria for inoculating the pit so that satisfactory results can be obtained.

The contents of many heavy metallic salts in the tanning mud of the Shanghai Hongguang Tannery surpassed the allowable concentration for normal anerobic microbiological fermentation by 7 to 20 times. Many times of taming and inoculation were unsuccessful. After many tries, they finally used bubbling mud similar to the fermenting raw material in property (naturally aged mud) and conducted strict and directional taming and screening and they finally achieved success and realized the good result of using tanning mud for medium temperature methane fermentation with a gas production rate of 1 to 1.4 cubic meters/cubic meter/unit raw material/day (surpassing the expected goal of 0.5 cubic meters/cubic meter/unit raw material/day).

In addition, the Qingdao City Fertilizer Plant and the Nanyang Alcohol Plant also felt the same way about the important function of taming and screening bacteria.

6. The problem of treating the resi[illegible] The most troublesome problem in producing methane in cities and i[illegible]ories is the treatment of residue. After garbage undergoes anaerobic digestion, the amount of substance harmful to the environment is greatly reduced but still the residue does not meet the standard for release and concerned departments still do not release it. This is like swallowing something without being able to pull it out again. If the residue is to be treated, a large amount of funds is required (building aeration tanks), seriously discouraging the enthusiasm of factories to produce methane gas. To solve this problem and to promote the cities and factories to develop methane gas, everyone believes the following two problems must be solved:

(1) Not collecting or collecting garbage fees according to the degree of pollution to encourage the cities and factories to develop methane gas. After organic wastes of the cities and factories have been fermented for methane, the main biochemical indicators have dropped greatly. BOD_5 has dropped 80 percent to 90 percent and COD_{or} has dropped 60 percent to 75 percent. Other physical indicators have also improved by a relatively large scale, and environmental pollution has been lessened by 70 percent to 80 percent. After separating the residues, the residues have been used for fertilizers or fuel and the liquid has been allowed to be released. Environmental protection departments and units that have developed methane and reduced pollution will not have to pay garbage fees or their garbage fees can be reduced according to the degree of lessening of pollution. In this way, the enthusiasm of factories to develop methane gas can be stimulated. If all factories that should develop methane gas have done so, the total amount of environmental

pollution will be reduced (by 70 percent to 80 percent) and more energy sources could be obtained. This is very beneficial to protecting the ecological balance and people's health.

(2) After anaerobic fermentation, the waste material should be subjected to aeration treatment. In this survey, the following problem has become apparent: Under the present technical standard and equipment available in the cities and factories, it is not possible to achieve the standards for release of waste established by the state via methane fermentation to treat organic waste. If waste is only allowed to be released after this standard has been achieved, then waste must be re-subjected to aeration treatment after methane fermentation (Aeration treatement requires building aeration tanks). The investment is large as is the consumption of energy. The area of land occupied is large). According to our nation's situation, the technical standards and the actual situation, aeration treatment is im-practical. Therefore we believe, in these two methods of treatment, the former is better and we hope environmental protection departments will consider it.

In utilizing the residues from fermentation, Shunde in Guangdong conducted the following experiment:

A. Shunde used sediments from methane production to replace cattle dung for planting mushrooms and used three different treatments. Each treatment was repeated three times in comparative experiments. One used only methane sediments, one used only cattle dung and sediments, one used half cattle dung and half sediments. The experimental results showed that three types of treatments produced similar yields. Although this was so, the masses complained: "Mushrooms planted in methane sediments produced mushrooms earlier than those planted in cattle dung that was not fermented in the pits, there were less diseases and the yields were stable." This eliminated the worry that using methane sediments to plant mushrooms was poorer than using cattle dung, and thus the conflict of competing for cattle dung to produce methane and for planting mushrooms was solved.

B. Shunde used methane fertilizers to cultivate fish. Shude County's Shayao Commune is a special economic zone mainly for cultivating fish in ponds. The income from fisheries constitutes a large proportion. The farmers believed that human excrement and animal manure from the pits were not fertile and that they affected yield, therefore they did not allow human excrement and animal manure to be put into the pits and they were not willing to use the fertilizers from the pits (Liede Power Station stopped production because human excrement left after fermentation could not be disposed of). The whole commune had 2,600 pits. All ceased production because of this problem. To convince everyone, they built independent pits to raise hogs and assigned two persons with experience in raising fish and developing methane to manage the work. They conducted a comparative experiment to use hog manure after fermenting in the pits and fresh hog manure to raise fish. The other conditions were the same but the fertilizers used were different (the manure excreted by the same hog was evenly divided into two piles: one pile was placed in the pit for fermentation, the other pile was placed in a covered manure vat. Every day, an equal amount of manure was removed from the pit and from the vat separately and fed into the control fish ponds). After 282 days of experiment, the results showed that the catch of live fish from the pond fed methane pit manure weighed 80.8 jin. The catch of live fish from the pond fed fresh hog manure weighed 75.6 jin with 8.6 jin of dead fish, totaling 84.2 jin. Calculating the yield of live fish, methane pit manure increased the yield by 6.87 percent. If the dead fish were included, the application of fresh hog manure produced an increase of 4.2 percent in yield of the yield produced by the methane pit manure. The yields were not too different. But, according to observation of the personnel and analysis of water quality, the water quality of the fish pond fed methane pit manure was clear. It had less floating surface material. It had less disease. The percentage of living fish was high and the yield was guaranteed. Although the fish pond fed fresh hog manure produced a slightly higher yield than the pond fed methane manure (adding the number of dead fish), the amount of dissolved oxygen was less. There were more disease causing bacteria, and therefore, there were more floating surface material, there were more diseases, and the yield of live fish was not guaranteed as that of the pond fed methane pit manure. It seems that each has its merits but they require further tests.

7. Reforming the air mixer improved thermal efficiency: The methane power station of Shayao Commune changed the "⊣ type" methane air mixer on the 2105 motor to a cylindrical methane gas mixer to improve thermal efficiency and solved the problems of deficient intake of air by the "⊣ type" mixer and the uneven mixture of methane gas and air. The ratio of the mixture of methane and air was increased from the original 1:7 (the theoretical ratio is 1:10) to 1:15. Therefore, methane gas could burn more fully. Methane gas containing 68 percent to 70 percent of methane per cubic meter can generate 2 kilowatt-hours of electricity, conserving 40 percent methane compared to the "⊣ type" mixer. We believe this reform is worth conscientious popularization in farm villages for generation of electricity by small methane pits.

[Written by Guo Shiying [6753 0013 5391] of the Chengdu Methane Science Institute of the Ministry of Agriculture. Besides comrade Guo Shiying, those participating in the survey also included Mao Yongcheng [3029 3057 2052], He Yudong [0149 0060 2639], Cao Tinghua [2580 1694 5478], Xiao Xiang [5135 3276], Zhan Guangju [6124 0342 5282] and Guo Dejing [6753 1795 6855] comrades]

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ALTERNATE ENERGY RESOURCES AND CONSERVATION

SHANDONG ASSESSES POTENTIAL OF SOLAR ENERGY, METHANE

Jinan DAZHONG RIBAO in Chinese 5 Feb 82 p 2

[Article by Cai Zongjian [5591 1350 0256]: "Actively Promote the Development of Unlimited Energy Resources"]

[Text] With the development of agricultural and industrial production, the energy shortage problem in Shandong is becoming more pronounced every day. The way to resolve the problem involves both development and conservation, with conservation being given priority of late. On the development side, however, attention should be given both to present needs and long-term development. At this point I would like to make the following proposals concerning the development problem:

Energy can generally be divided into two major categories: The first consists of coal, petroleum, natural gas, etc. These are fossil fuels which have been formed gradually by organic material which has been buried for hundreds of millions of years. These reserves are limited and cannot be renewed in a short period of time, so they are termed limited energy resources. The second consists of solar power, hydropower, wind power, tidal power, geothermal power, wave power, [power from] ocean temperature differentials, atomic energy, as well as animal power, plants, marsh gas and other such bioenergy sources. Some of these reserves are enormous, and can be said to be inexhaustible, while some can be renewed over and over again, so they are termed unlimited. There are abundant reserves of both of these energy resources in Shandong, and whether we are talking about the present or about the long run, both should be actively developed, and neither should be neglected. As for the unlimited energy resources, we think that the following kinds should be vigorously developed:

1. Solar energy. Our province is located at a latitude of 35-38°N, and the average annual solar radiation it receives is approximately 1.2 million kilocalories/m^2, comparable to the calorific capacity of 240 kg of raw coal. This is to say that the amount of solar heat reaching our province's 150,000 sq km every year is equal to approximately 36 billion tons of raw coal. Most of this heat, with the exception of a very small amount which is absorbed by crops, trees and weeds and transformed into bioenergy and stored, is absorbed by the atmosphere, the earth, and houses, and then at night released back into space. Therefore some method should be devised to utilize it. Foreign research on the utilization of solar energy began at a very early date, and

some countries have already entered the utilization stage. China did not begin research on this until the 1950s, and there have been rather significant developments in recent years. For example, considerable experience has been gained in such areas as the construction of solar energy water heaters, solar ovens, solar hothouses, driers, distillers, and in the utilization of solar energy to regulate room temperatures. Some advances have also been made in the development of solar batteries. Solar energy is everywhere, and its utilization does not pollute the environment, which makes it very suitable for large cities and the countryside. In particular, now that the manufacture of solar water heaters, solar ovens and other such technology has come of age, if we can adopt steps to lower the costs somewhat, then in rural areas we can vigorously promote box-type solar ovens with relatively large collection areas, or stationary condenser-type solar ovens, which can be used to cook lunch or heat water on sunny days. In cities the residents can use solar ovens in the courtyards or on the balconies. Solar water heaters can be installed in agencies, schools, factories, military units, bath houses, restaurants, barber shops and other such units to get hot water for bathing, washing one's hair, washing clothes and heating. When building new dormitories we can use heat-storing walls and "solar chimneys," etc., to regulate room temperatures. By making the most of what we have in this way, we can save a great amount of energy and reduce environmental pollution as well. According to calculations, if every one of the 17 million households throughout the province had a solar oven with a collective surface of 1 sq meter, the solar energy collected yearly would be equivalent to the calorific content of 2 million tons of raw coal, and if you figure on the basis of a 50 percent utilization rate, this is equal to exploiting a coal mine with an annual output of 1 million tons, and in addition it would save a great deal of coal transportation costs and reduce investments by more than 100 million yuan. Industrial boilers can also be equipped with solar energy water heaters to preheat the cold water going into them and thereby save energy. It is calculated that raising the temperature of 1 ton of cold water from 20°C to 80°C before putting it into the boiler can generally save about 12 kg of coal. Figuring on the basis of 200 sunny days a year, and a little over 8 hours a day, we can save 10 tons of coal per year. If this is popularized on a wide basis, the energy savings are quite obvious. For this reason I propose: 1) Actively produce and supply plastic film, glass, lenses, aluminum-coated film and other such transparent and reflective materials, and support the rural popularization of box-type solar ovens and simple condenser-type solar ovens.
2) Arrange for some factories to produce domestic solar energy water heaters and condenser-type solar ovens, and encourage factories, agencies, schools and residents to install and use them, and also do our utmost to install solar energy water-feeder preheaters on industrial heat-supply boilers. By way of encouraging the production of such things and boosting the enthusiasm of oven factories, a certain amount of money can be set aside from the economic gains of the energy savings to serve as subsidies for losses incurred.
3) Arrange for cooperation between the electronics industry sector and concerned universities to speed up the development of non-crystalline solar batteries and achieve a technological breakthrough as soon as possible so that commercialization is possible.

II. Marsh gas. The major component of marsh gas is methane. According to tests, with the exception of lignose and mineral oil, almost all organic materials can be the raw material for marsh gas. When a cubic meter of marsh gas burns, it releases 5500-6500 kilocalories of thermal energy, comparable to more than 1 kg of raw coal. In actual use, because the combustion of marsh gas is fairly complete, its utilizaton rate can match that of 2-3 kg of raw coal. Our province has a great amount of material that can serve as raw material for making marsh gas, so we should develop it vigorously. At present, the vast majority of rural areas still uses crop leaves and stalks as fuel, which is very regrettable, since this not only destroys its effectiveness as organic fertilizer, in addition only 10 percent of its calorific capacity is utilized. Using it to manufacture marsh gas, however, makes it possible to utilize approximately 50 percent of its calorific capacity, and the wastewater and residues left over make highly effective fertilizer. A five-family peasant household will burn approximately 10 kg of crop leaves and stalks daily, but if this is used to make marsh gas (each kg of plant leaves and stalks can produce 0.3 cubic meters of marsh gas), it would be enough to meet daily needs for three to four days. Our province has a total of 15 million peasant households, and if all of them built methane pits which produced 1 cubic meter of methane daily, calculating on the basis of 300 production days yearly, we could save nearly 63 billion jin of crop leaves and stalks a year. Now if the leaves and stalks are amassed and a series of fairly large methane pits are built, this could replace the diesel oil, gasoline, etc., that are used to generate electricity, and alleviate the rural energy shortage. If they are used as fodder for livestock, and the manure from the livestock is used to produce marsh gas, then we can get even more animal power and animal products as well as marsh gas and fertilizer. At the same time, because in the process of making the marsh gas the parasites in the manure are killed, it is also beneficial to the health of people and animals, so it is truly a case of killing two birds with one stone. Actually, not only can marsh gas function as a source of energy for rural areas, it can also provide energy for urban residents. Cities and towns have manure and garbage, as well as the organic residues from breweries and food processing plants, etc., and if we build methane fertilizer plants, not only can the methane produced serve as fuel for the everyday needs of the people or be put in methane containers for use in buses, the wastewater and residues left over can go to the suburban areas to be used as fertilizer. In addition, the proper handling of the manure, garbage and polluted water will reduce environmental pollution. According to calculations, a town of 100,000 people discharges about 100 tons of excrement daily, which can produce 30,000 cubic meters of marsh gas, which has a calorific capacity equal to 30 tons of raw coal. If the 100 cities and towns throughout the province all build such methane fertilizer plants, the methane produced annually will be equivalent to 1 million tons of raw coal, which is equal to exploiting a large coal mine. The present problem is that building methane pits not only requires capital and materials, the gas production rate is also not high enough. Therefore I propose: Beginning now we should actively study new techniques to increase the methane gas production rate, and in addition to using [methane] widely for domestic purposes, we should gradually convert tractors and cars to methane. Cities and towns with the proper conditions can set up medium and large methane fertilizer plants on a trial basis, and after experience is gained, this can be passed on so that gradually every xian will have its own plant.

III. We should adapt to local conditions and develop water power, wind power, tidal power, geothermal power, ocean wave power and other such energy resources, and at the same time work hard at afforestation and the development of livestock [resources] in order to fully utilize the unlimited energy resources.

In sum, what we have in mind is: While we are vigorously developing coal, oil and other limited energy resources, we must by no means neglect the unlimited energy resources, and we must utilize every possible energy resource. The things we should strive to gradually active in the not-too-distant future are: With the exception of electric-power irrigation and pumping stations and other such medium and large water irrigation projects which depend upon power grids for their electricity, rural energy [needs], such as farm-use motive power, domestic [energy], lighting, etc., should rely more on methane, solar power, small hydropower stations, small methane power stations, animal power and other such unlimited energy resources that can be exploited locally. With the exception of supplementary coal for heating during the winter, domestic energy for residents of cities and towns should come primarily from solar energy and methane, in order to conserve large amounts of limited energy resources.

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NEW BREAKTHROUGHS GIVE ADDED PROMISE TO SOLAR ENERGY DEVELOPMENT

Chongqing XIN NENG YUAN [NEW ENERGY SOURCES] in Chinese Vol 4 No 1, 5 Jan 82 pp 1-7

[Article by Li Mengming [2621 1322 6900]: "Development of Our Nation's Solar Energy--Notes on the 1981 Annual Meeting of the China Solar Energy Society"]

[Text] The China Solar Energy Society held its annual meeting from October 6 to 10 October 1981, in Hangzhou. A total of 252 delegates attended. Leading comrades of the Zhejiang Provincial Science Committee and the Provincial Science Association attended the opening ceremony.

It was a lively meeting marked by solidarity and activity. The meeting adopted the working report of the National Council. Since the 1979 Xi'an Conference, China's solar energy applications and research have made great strides. The membership of the society has doubled, and the special fields the society has become involved in have continued to expand. Now, seven special groups in the utilization of solar heat, solar powered machinery, thermal power generation, solar heating and air conditioning, photoelectricity, photochemistry, bioenergy and solar energy resources and materials have been officially established, and preparations are being made to establish a special committee on wind energy. The society organized and conducted a survey of these special fields and presented nine special reports to the conference. The conference heard reports by China's delegation to the UN conference on new and renewable energy sources and by the society's delegates to the academic discussion meeting of the International Solar Energy Conference.

After a serious discussion by the delegates, the conference in principle adopted "Suggestions concerning scientific research, production, application and utilization of solar energy in our nation."

This conference received a total of 278 papers. After review by members of the professions, 102 papers were selected for group exchange and were posted for public view to serve as the key discussion topics in academic exchange. The academic level of the papers has visibly improved over that of previous years. The regional distribution of the units where the authors serve has also broadened from previous years. This will actively promote the future development of solar energy utilization in our nation.

In our nation, solar energy is an auxiliary energy resource that can be realized. The following is a general review of the present development of solar energy in our nation as refelcted at this conference. The review is presented as a reference for readers.

I. Solar Water Heater

The solar water heater is one of the solar energy devices that is the most mature and most practical in the present stage of the technology of solar energy and solar heat utilization in our nation. In recent years, our nation has utilized solar energy to partially replace ordinary energy sources and to provide low temperature hot water for daily living. Now, over 20 major research units and higher educational institutions are engaged in the development of solar water heaters. The varieties developed have increased over those of 2 years ago and the quality has visibly improved. A group of new technologies to produce heat absorbers in batches, such as the flat box type aluminum heat absorber formed by hot rolling, pressurized blowing, molding under pressure and welding developed in Beijing. Shanghai and Dalian developed the extrusion formed wing aluminum tube heat absorber and the welded top and bottom box heat absorber. The structure of these heat absorbers has a relatively high thermal efficiency and is easy to produce in batches. Beijing, Shanghai, Anhui, and Qingdao are trial producing black heat absorbers of black plastic and black enamel. Prototypes have been made and definite achievements have been realized in solving the problems of rusting of steel materials and prevention of water pollution. The source for pottery and porcelain raw materials is plentiful. The cost is low. The ability to resist corrosion is strong. They are an attractive heat absorbing material. Research in high temperature heat collectors has made breakthroughs. For example, Shenyang and Beijing have developed glass vacuum heat collectors. Their heat gathering ability approaches international standards and they are now systematically undergoing intermediate experiments. Shanghai, Beijing, Hebei, Henan, Anhui, and Guangdong have developed on a trial basis various types of covered household water heaters that are simple in structure and low in cost. For example, Shanghai's internal circulation type aluminum household water heater can provide 120 kilograms of 40 to 60°C of hot water a day with 1 square meter of light-gathering surface in spring and autumn. Beijing's double barrel household water heater can provide 60 kilograms of 40 to 50°C of hot water a day with a 0.5 square meter light-gathering surface when used from April to October. Each costs 55 yuan. The research standard in water heaters has improved. For example, the solar panels all comply with the temporary standards for instantaneous efficiency curves, time constants and $K_{\tau\alpha}$ and the correction function of the angle of incidence as determined domestically. The covered household water heater has been tested for full day efficiency under definite climatic conditions. Beijing studied the problem of combining solar water heaters and buildings. Natural circulation type household solar water heating systems have been installed in some units in dormitories. The area of the heat collector per household is 0.7 to 1.3 square meters. The water tank has a capacity of 70 to 100 liters. After one year of testing, the residents said the systems worked well and believed that they have solved the problem of taking baths at home. To include the water heater as a facility of buildings and to popularize it over large areas, further study is needed to solve many practical problems. The question of using solar water heating systems throughout the year in the northern regions has attracted people's attention. In Shenyang, during the winter of 1980, the vacuum tube heat collector was tested. The 28-square-meter water heater produced 600 liters of 60°C hot water under temperature of -10°C to -20°C. During the night, the vacuum tube did not freeze. In Beijing, a naturally circulating compound circuit anti-freezing water heating system was preliminarily tested for intermediate wintering experiments. The system includes a 3.6-square-meter solar panel, a water tank of 300 liters containing a submerged panel heat exchanger. The heat exchanger and the heat collector form a naturally circulating circuit that contains anti-freeze liquid. The system has passed the winter of 1980. On clear days, it can provide 80 to 100 liters of 40°C hot water.

China has the beginning of a solar water heater industry with over 30 solar water heater processing factories of different production scale throughout the country. They are distributed in a dozen provinces and cities. The present products include steel pipe and steel plate panel heat collectors, flat tube heat collectors, zinc plated iron box heat collectors, corrugated heat collectors, aluminum hot rolled, pressurized blown type heat collectors and extrusion formed wing aluminum tube panel heat collectors. Annual output has reached several dozen thousand square meters of light-gathering surface. The price is about 70 to 160 yuan/square meter. Up to now, about 100,000 square meters of light-gathering surface of solar water heaters have been used. They are mostly used by units and agencies and service professions such as barber shops, bath houses, hotels, and restaurants. In recent years, as the farm village economy prospers and as the income of farmers increases, shallow pool type household water heaters have become popular. For example, in a production team in Beijing, every commune member household has a solar shower room. The roof of the shower room is a shallow pool type water heater. The cost of each water heater is about 50 yuan. In addition, solar water heaters have also expanded their scope of usefulness in industrial and agricultural production. For example, Tianjin has begun to use low temperature solar water heaters in certain production processes. They are used in the soaking of silk in silk dying plants. They are used to wash and clean machine parts at textile machinery plants. They are used in the acid pickling and phosphorization processes in electrical appliances factories at mines. They are used in the sauce manufacturing shops of food seasoning factories for heating the bottom of sauce brewing pools to promote fermentation. Anyang in Henan has already used solar heated water to incubate chicken eggs. Jiangxi has used solar heated water to cultivate fish and they have all realized definite results. According to surveys and estimates, each square meter of the solar water heater can conserve 200 to 300 kilograms of coal each year.

II. Solar Stoves

The popularization and application of solar stoves in our nation's farm villages have practical significance in solving the problems of fuel in farm villages. Certain regions of farm villages, border and remote regions which lack fuel urgently need to solve the problem of fuel. According to incomplete statistics, since the Xian conference in 1979, the nation already has over 20 provinces, cities and autonomous regions which have popularized the use of solar stoves to varying degrees. Now, over 100,000 solar stoves are being used in farm villages. There are many models. They can be categorized into the following few types:

1. Box solar stove. The box solar stove utilizes the principle of the hot chamber effect to continuously accumulate solar energy for steaming food. The stove has the advantage of being simple in structure. Farmers can make the stoves themselves. The manufacturing cost is low. Cooking with them is convenient, and the stoves do not need to be supervised by special personnel. Their deficiency is that efficiency is low. The solar energy gathered is limited. The temperature generally reaches only 110 to 150°C and the stove cannot be used for stir-frying foods. At present, this type of solar stove is not commonly used in our nation. Our nation has many units which have developed different types of box solar stoves, such as the 701 - 703 solar stove of Anyang in Henan, the improved box stove made by the Kunming Normal College, the PF box stove made by the Handan Optical Instruments Plant of Hebei, the straw box stove made by the Dantu Telecommunications Meters Plant of Jiangsu, the sterilization stove made by the Guanlin Commune Health Clinic in Luoyang, the FTZ-1 stove made by the solar energy group of Dandong City, and the stoves developed by the Beijing Chemical Engineering Academy, the Nanjing Xinning Middle School, and the Luoyang Middle School No. 20.

2. Light focusing solar stove. This is the most common and the most practical stove in our nation at present. It can focus more solar heat. The temperature at the bottom of the cooking pot can generally reach 400 to 1,200°C, suitable for steaming, boiling, cooking, frying, and stir frying. The heat is equivalent to the commonly used honeycomb coal briquet stove of most households. Its thermal efficiency is generally 50 percent. The material of the casing of the light focusing solar stove determines efficiency, life, cost and degree of practicality. Most of the stoves used in our nation have a reinforced cement structure. Some have suited measures to local circumstances and used local materials, such as plaster, paper, iron sheets, glass fiber reinforced plastic, and calcium plastics. The material for the reflecting mirror was once super-anodized oxidized aluminum plates or nickel plated metallic plates. Later, because the cost was too high, most changed to silver plated glass cut into small pieces, pasted together and shaped in a bend. But this type of mirror easily peels off because of corrosion and easily breaks, and generally the mirror has to be replaced once a year. The aluminum plated polyester membrane recently developed successfully in a more ideal design in structure and more rational, and it visibly reduces the weight of the stove. The shortcoming of the light focusing solar stove is that its heat is easily lost and, especially when there is wind, the stove is easily tipped over, and this is dangerous. Therefore, when designing the stove, consideration must be given to adding windbreaks and to protect the stove. In addition, the alignment of this type of stove must be adjusted every 15 to 20 minutes to track the sun. Therefore, consideration must be given to designing a simple automatic solar tracking device. Also because of the intermittance of the sun, sometimes temporary clouds may block out sunlight, and food that is being cooked may only be half cooked. Therefore,

this type of solar stove has limited use in southern regions. The method of solving this problem may be to consider adding a storage device or combine the stove with methane gas in use. At present, the following units are engaged in developing light focusing stove. These and the types of stoves are described below: The Southern Gansu Science Committee has made the paper box cement stove. The Technology and Arts Plant of Zhangye County has made the rectangular concave glass stove. The Linxi Science Committee in Hebei has made the HB-3 cement lingku indigenous stove. There are also the wooden frame paper board stove of Sanzhong in Zhengzhou, the F series honeycomb glass fiber reinforced plastic stove made by the Zhengzhou Engineering College, the cement stove made by the Lucheng Solar Energy Institute of Henan, the cement stove made by the Haian Solar Energy Institute in Jiangsu, the TH80-25 fiber board stove made by Taihe County in Anhui, the QH-1 stove made by the Qinghai Motion Picture Machinery Plant, the hollow -1.52 pulp stove made by the Wuqi Science Committee in Shaanxi, the pulp stove made by the science committee of Yanan, the plywood board stove made by the Xizang Industrial Design Academy, the square stove made by the 122 Engineering Bureau of the Water Conservancy and Electric power Ministry, the veneer board stove made by Jilin Normal University, the stove with a 3.6 square meter light gathering surface made by the Hubei Science Committee, the embrella iron sheet stove, the square calcium plastic stove, the center focusing stove, and the TZ-4 lotus shaped aluminum stove. The smallest light gathering surface is 0.67 square meters. The largest is 3.6 square meters. The focal distance is 650 to 850 millimeters. The highest temperature of the focal spot is 1500°C, and the thermal efficiency can reach over 60 percent.

3. Solar steamer. This type of stove boils water to produce steam for steaming food. The small stove can be made into a flat stove. The large stove can be designed as an automatic tracking solar light focusing stove. The main characteristic is that the cooking part and the solar heating part are separate, therefore the working condition of the cook is improved and the cookware can be kept clean easily. This stove can be used in collective mess halls as long as there is a sufficiently large light gathering surface. Because it utilizes steam to steam and cook foods, the requirements of the seal of the evaporator is very strict. At present, the following units are developing solar steamers in our nation: Jianhu County Science Committee in Jiangsu, the Xi'an City Zoo in Shaanxi (ϕ 6 meters), the Dongzhuang Supply and Marketing Cooperative in Qufu in Shandong (ϕ 8 meters), the Lucheng County Science Committee in Henan ($S = 7.5$ square meters), the Sichuan Provincial Architectural Surveying and Design Institute ($S = 3.76$ square meters).

The solar stove has already shown its superiority in popularization and application in the broad number of farm villages in our nation, especially in farm villages lacking fuel. Its economic benefit is obvious. For example, the Tanhe No 8 Team in Haian County in Jiangsu has 34 farm families. Before using solar stoves, there was a shortage of 20,000 to 30,000 jin of firewood each year and the state supplied 5,000 jin of coal to them but this was not enough for everyone. Since 1978, this team built 21 ϕ2 meter light focusing cement solar stoves and 6 methane pits. By 1979, they did not want any more state supplied coal. Firewood was sufficient and there was a surplus, and 4,000 jin of stems were saved and returned to the fields in an experiment to improve the soil. According to statistics, each solar stove can conserve an average of more than 1,100 jin of firewood a year. Converted to the local price for firewood, this was a saving of 22 yuan. The solar stove with the best results can conserve 2,330 jin of firewood, equivalent to 46.60 yuan. Whether the use and management of the solar stove is good or not greatly affects conservation. When it is used well, one stove can conserve 2,000 to 2,500 jin of firewood. A stove of medium efficiency can conserve 1,200 to 1,500 jin while a poorly efficient stove can only conserve 700 jin. Of the 21 solar stoves at the Tanhe No 8 Team, 23.8 percent of the stoves were used efficiently, 42.85 percent of the stoves were used with medium efficiency and 33.35 percent were used poorly. Again, for example, the Songshuwan Brigade of Yangta Commune in Yongqing County in Gansu Province has 188 farm families. Every family is using a solar stove. The actual results showed that the whole brigade could conserve over 399,000 jin of firewood a year. Converted to the local price of firewood, each solar stove could conserve an average of about 100 yuan a year. Therefore, the cost of the solar stove was recovered in the same year.

Popularizing the use of solar stoves in farm villages has the following advantages: 1) They conserve labor and they conserve firewood; 2) They are a convenience for the masses and they increase the income of commune members; 3) They increase feed grasses and fertilizers and they promote agricultural and livestock development; 4) They protect forest wood and they reduce soil erosion.

III. Solar dryers

Research and popularization of using solar energy to dry industrial and agricultural products have developed rapidly in recent years in our nation. According to incomplete statistics, at present, there are more than 30 various types of solar dryers throughout the nation. Most of them were built after 1979. These solar dryers can be generally classified into four types:

1. Greenhouse type dryer. Its structure is similar to the green house for cultivating plants. Its characteristic is that the heat gathering part is joined to the drying chamber. A heat insulating wall generally faces north. The inside wall is painted black. Heat insulating walls or transparent glass walls face the south, the east and west. The glass roof inclines towards the south. The slope equals the degree of the geographic latitude. There is an exhaust chimney on top of the north wall. Below the south wall is an air intake duct. Material is placed in dishes inside the chamber. The sunlight shines through the glass and directly upon the material and is absorbed by the inner wall. The indoor temperature and humidity are controlled by the exhaust vent and door. The solar dryer for drying jujube in Jishan County, Shanxi Province is such a type. The indoor temperature during summer can reach 50 to 60°C and 10 to 20°C in winter. This type of dryer which absorbs sunlight directly is suitable for drying jujube, day lily, pepper, peanuts, cotton, grains which are agricultural products that can be directly exposed and dried under sunlight. Jishan County, Shanxi Province, has also

built a natural circulation dryer which includes an indirect drying chamber. A supplementary drying chamber is built behind (north side) the direct sunlight absorbing dryer. This type of dryer is used for drying agricultural products which are not suitable for direct exposure to sunlight, such as tobacco.

2. Heat gathering dryer. Its structural characteristic is a separate drying chamber and a heat collector, such as the solar drying kiln for lumber built in Feixi in Anhui, the pilose antler dryer in Xi'an and the rubber dryer in Hainan Island all belong to this type. This type of dryer can also be used with ordinary coal furnaces or methane burners for continuous operation at night or on overcast days. For example, the solar tobaccl leaf dryer in Changge County in Henan has a coal burner. The strip bean curd dryer at the Huangxi Cultivation Farm in Xinjian County in Jiangxi has a methane burner. The Feixi timber drying kiln not only has a wood burner, it also has a heat storage. Abroad, large solar dryers are mostly mixed heat collecting dryers.

3. Heat collector-green house type dryer. This is a combination of a heat collector and a green house type dryer. The material contained in the dishes not only absorbs the sunlight that shines through the glass roof directly, the material is also ventilated by the hot air provided by the heat collector, thus combining the advantages of the green house type dryer and the heat collecting dryer. Preliminary experiments at the Guangzhou Energy Research Institute showed that when the ratio of the room temperature and the area of the heat collector is 1:1, the drying temperature can be raised 5 to 10°C (related to weather conditions). This type of dryer is suited for products that require a higher stoving temperature and that must be dried intermittently, such as fruits and silkworm cocoons. The tunnel type solar dryer for fruits in Dongwan County in Guangdong belongs to this type. Its heat collector and the light gathering surface of the green house are 31 square meters and 27 square meters respectively. It uses a charcoal burner as an auxiliary heat source. The tunnel kiln can contain about 2,800 jin. A ventilator is used to force hot air to permeate the drying material. When the air flow is 800 cubic meters/hour, the temperature in the green house on a clear day can reach 50 to 70°C. Fruit is dried and removed from the kiln after 6 days.

4. Light gathering dryer. It consists mainly of a columnar parabolic mirror surface, a tube absorber, a slow cooler, a lift for transporting the materials for drying and a tracking system. Xingtai in Hebei in Quwo County in Shanxi have successfully built on a trial basis this type of dryer for use in drying food grains. The largest is the dryer at Xingtai. It has three groups of light focusing mirrors covering an area of 90 square meters. The thermal efficiency is about 40 percent. The temperature of the absorber is 80 to 120°C. The percentage of precipitation is 1.5 percent to 2.0 percent. The insecticidal rate is above 95 percent. The daily amount of food grains dried is between 20 and 25 tons. This kind of dryer is structurally complex. The building cost is high, but it uses 50 percent less electricity than the thermal roller type food grains dryer and 97 percent less electricity than the high frequency media food grains dryer. Yet, drying grains usually requires

lower temperatures and costly high temperature fast drying systems are not necessary. Therefore, the suitability of using the light focusing solar dryer to dry grains is worth studying.

At present, most of the solar energy dryers in our nation are low temperature dryers. The green house type dryer is structurally simple, easy to build, convenient to manage, does not require a lot of investment, and the results are visible. For example, the green house type solar dryer of the Eighth Production Team of the Yaocun Brigade in Jishan County in Shanxi can stove dry 6,000 jin of red dates each day and it can also be used to dry wheat, water caltrop (?), pepper, noodles and such agricultural products. The percentage of rotten dates has dropped from the 10 to 20 percent when the natural cooling and drying method was used to 2 to 3 percent utilizing solar energy to dry red dates. The outer shape of the red dates is plump, the color is bright red, the taste is good, and the grades of the wind blown dates have been improved. The Shanghai National Cotton Plant No 1 has 12 drying chambers. They require a temperature of about 40°C. Originally, these drying chambers used infrared lamps to raise temperature for drying. Each year, they consume as much as 90,000 kilowatt-hours of electricity. Later, waste and old materials were utilized to make an aeration heat collector of 12.2 square meters and it was placed in front of 4 drying chambers. The drying chambers were rebuilt to utilize both electricity and solar energy. On clear days, solar energy was used for drying and electricity was used on overcast and rainy days for drying. Each year, about 20,000 kilowatt-hours of electricity can be conserved while the investment is small. The northern textile steel wire drying chamber of that plant spent 85 yuan on materials for making a 2.8 square meter aeration heat collector.

IV. Solar House

According to our nation's energy situation, actively studying and building solar energy houses suitable to the requirements of our nation's farm villages and cities, especially passive type solar houses, have practical significance. According to incomplete statistics, since 1977, our nation has already built or is building a dozen experimental solar houses. Scientific research in passive solar energy heated houses has progressed quickly from small experimental houses to application in practical buildings. This has attracted widespread attention. For example, the solar house of the Quanji Postal and Telecommunications Institute in Gangca County jointly designed by the Qinghai Provincial Architectural Surveying and Design Institute and the Qinghai Provincial Postal and Telecommunications Science Research Institute was completed in 1979. It is now being used. The solar house is a single story five room house. The outer and inner walls are all brick with a sandwiched layer of sawdust of 120 millimeters thick. The roof is made of reinforced concrete plates and the floor is concrete. The storage room is not heated. The required indoor temperature of the three work rooms is above 10°C. Heating is accomplished by a large area heat storage wall covering the outer wall of the south side for passive heating by solar heat using a direct gain glass window. To enlarge the area of the heat storage wall, the wall is extended 1.2 meters into the ground and 0.9 meters towards the east and west. The transparent layer of the heat storage wall is a layer of glass and a layer of dylon. Measurements taken over two winters showed that when the outdoor temperature was below -10°C (the lowest temperature was -25.5°C), the indoor temperature remained basically above 10°C, higher than the room temperature in the unheated rooms by 15 to 20°C. The auxiliary heating source was not used during the two winter seasons. Building the passive solar house has already realized results in energy conservation. For example, Tianjin University designed and built a single story passive solar heated house covering 170 square meters for the Wuqing County Government Hostel in the winter of 1979. After using the house, measurements showed that while maintaining the indoor temperature to above 10°C, the house conserved 77.3 percent in energy consumption. The highest indoor temperature reached 17°C. Utilization of solar energy for heating requires buildings to have means of collecting heat, temperature insulation and heat storage. Thus, the building cost per square meter is generally higher by 14.3 yuan. If the area and the number of stories of the building are increased, the building cost can be lowered and the results of energy conservation can improve.

Our nation has begun to study and develop multiple story residential buildings with passive solar heating in cities. For example, the Shijiazhuang City Housing Administration of Hebei and the Hebei Provincial Energy Reserach Institute built a five story residential building in the Qiaodong Ward in Shijiazhuang City in 1980. A room at the center of the building was used as the passive solar heating experimental room and the surface of the windowless south wall was used to set up a vertical air heat collector. The effective heat gathering surface covered 47 percent of the standing face of the south wall. Preliminary test results showed that the indoor temperature was generally maintained at between 10 and 16°C while the indoor temperatures of the rooms not heated by solar energy reached a high of 4 to 6°C and dropped to a low of -6.5°C. It can be seen that the results of using solar energy for heating is visible. The building cost per square meter is only higher by 9.31 yuan.

Several years of practice showed that the passive solar house is structurally simple, the cost is low, the results are good, management is convenient, and it has a bright future for popularization and application in our nation.

During recent years, our nation has also developed experimental research in active solar houses. For example, in 1978, the Natural Energy Research Institute of Gansu Province built a civilian active solar energy water heating and room heating experimental room. In the same year, the Qinghai Provincial Architectural Surveying Design Institute built a five-story office building of mixed structure in Xining City and used active solar energy driven hot air ventilation and direct gain glass windows for combined heating. Results of measurements showed that the room temperature reached 14.2 to 15.3°C, and solar energy supplied 80 percent of heat. The preliminary investment in the heating facility was higher than ordinary boiler room type heating facilities by 11.18 yuan/square meter. Calculating the fuel cost conserved, the investment can be recovered in 9.8 years. Qinghua University also built an active solar energy experimental room in the winter of 1979 to study thermal engineering characteristics of houses. It has also established a mathematical model and begun theoretical research in solar houses. In addition, the Air Conditioning Institute of the Chinese Architectural Sciences Research Academy, the Huazhong Engineering Academy and the Ningbo Dongfanghong Textile Plant built solar energy air conditioning systems and developed experimental research in solar energy air conditioned rooms.

Our nation has realized definite achievements in theoretical research in solar houses and materials research. For example, the Hebei Provincial Energy Research Institute has studied aqueous heat absorbing coatings and hydrated salt phase transformation heat storage. The Tianjin City Composite Materials Plant and such units have studied and developed polyester transparent glass reinforced plastics. Qinghua University and Shenyang City Architectural Engineering Research Institute studied and developed vacuum tube heat collectors, etc.

V. Solar Cells

In recent years, solar cells have been used more and more widely in our nation's border regions, on high mountains and isolated islands and remote regions far away from city power supply. For example, they are used in navigation lamps, railroad signals, communications power sources, and electrical fences in livestock regions, etc. The Qinghai Radio Plant No 4 and the Tiepujia Grazing Grass Improvement Experimental Station cooperated and successfully developed the solar energy powered electric fence used in the Qinghai—Xizang Plateau. Its structure consists of a silicon solar cell power source, a battery and a high voltage pulse generator in one unit of 380 x 300 x 200 millimeters in size and weighing 15 kilograms. It is portable and convenient to operate. When the livestock comes into contact with the zinc plated iron mesh, a series of peak high voltage pulses of 5 to 10 volts is sent instantaneously at a pulse width of 0.6 milliseconds. The electric power of the pulse is less than 2.5 milliamperes second and the interval between two neighboring pulses is 0.75 to 1.25 seconds. The electric guard fence has been produced in small batches on a trial basis and has been used in nearly 10 grazing stations in the Qinghai Plateau to keep domesticated sheep, yaks, camels, and dairy cows. The results are good. According to estimates, solar cells will continue to develop in the above directions of popularization and application in our nation in the future. As the cost of the matrix drops and as production increases, the scope of application will gradually expand.

At present, the battery that is produced in relatively large quantities and that is more practical in our nation is the monocrystal silicon solar cell. Many factories are producing this type of solar cells. The silicon material used is mostly waste or secondary monocrystaline silicon. Although the efficiency is slightly low, the cost is also low. But, the cost of the silicon solar cell constitutes a major portion of the cost of the power generating system. Therefore, the major task at present is to improve efficiency and reduce cost. The Shanghai Xinyu Power Source Factory has realized visible achievements in improving the conversion efficiency of silicon solar cells. They developed silicon solar cells with wired knot, dense grid and an aluminum background field. The photoelectric conversion rate reached 15.7 percent. The Tianjin 1418 Institute test produced a low cost and large area (ϕ 75 millimeters) silicon solar cell. Its typical performance was: AM1.5 according to total area, the conversion rate was 11 percent and the power was 0.4 watt. At the same time, it also successfully produced a small number of 75-millimeter batteries with a flossy surface and a background electric field which has shown an even higher conversion efficiency. The inherent advantage of large area cells is that it requires less time to manufacture them. The labor production rate is many times higher than producing small batteries of the same wattage. According to preliminary estimates, the cost of each watt is expected to drop to half that for producing the original 20 x 20 millimeter battery. A sample ϕ 100-millimeter battery has already been test produced successfully. Its area is almost onefold that of the ϕ 75-millimeter battery, therefore the labor production rate and the manufacturing cost will be more advanced and rational.

Other types of batteries, such as a-silicon, CdS, GaAs, MIS, multiple knot batteries, are also being developed in our nation. For example, the Changchun Applied Chemistry Institute of the Chinese Academy of Sciences has produced a low cost Cu_2 S/CdS agglutinant solar cell. The efficiency of the cell has reached 7.6 percent. Sunlight efficiency is 9.5 percent (calculating according to the effective surface area, it is 12 percent). The efficiency of the assembly matrix of the cell has reached above 6 percent. At present, the cells are tested and used on a trial basis in farm villages as power source for telecommunications, electric fences, lighting, power source for sprayers and atomizers for agricultural use. The Tianjin 1418 Institute has produced a large area MIS battery. The efficiency of the monocrystal silicon Mn-MIS battery has reached 8.6 percent. The efficiency of the multicrystal silicon Mn-MIS battery has reached 5.2 percent. The efficiency of the monocrystal silicon Cr-MIS battery has reached 7.4 percent. These efforts have proven that SnO_2 is an effective reflection reducing film.

The Ningbo Solar Energy Power Source Plant and the Power Machinery Plant have test produced a light focusing battery powered generator without automatic tracking. Compared to the flat board power generator under a light focusing ratio of 30 times, the output of power is the same while the number of solar cells used is less by 2/3.

To reduce the cost of sealing the batteries and to extend the useful life and realize automatic assembly, the Tianjin 14128 Institute is conducting research in the use of polyvinyl butyral (PVB) bags to seal silicon solar cells. The batteries were subjected to alternate temperatures of -40 to + 40°C, shock treatment of low temperatures of -55°C and high temperatures of +85°C, high temperature conditions (+55°C, relative humidity of over 95 percent) and several months of practical efficiency experiments. The outer appearance of the batteries and the electrical properties did not change.

Development of the solar cell industry in our nation is like industrialization of other products. We must start out from the actual situation, consider it uniformly, realize overall arrangement, seriously select and determine near term and long range technical paths of development according to our nation's solar energy resources, especially the resources of silica material, to provide an economical and rational new energy source.

VI. Methane Gas

Since 1979, our nation has built 1430,000 new methane pits on the foundation of summarizing past experience and lessons in our nation. Each one has basically been successfully built and visible results have been obtained. Up to now, our nation's farm villages have already built several million methane pits, nearly 800 methane motor power stations of over 9,000 horsepower, and more than 1,000 small methane electric power stations. They generally burn a mixture of methane and diesel oil. This conserves 40 percent to 60 percent of diesel fuel. Many years of practice proved that popularizing the use of methane in farm villages is an important way to solve the energy problems in farm villages. For example, the Third Production Team of the Hongqi Brigade of Jingbian Commune in Sichuan has built a total of 34 methane pits producing 7,259 cubic meters of gas a year, averaging 214 cubic meters of gas per pit. This can replace 3,210 jin of straws and each family can save 10 to 20 jin of lamp oil.

Since 1968, some cities and factories in our nation have used anerobic digestion to treat sewage and industrial waste water. Energy was obtained, environmental pollution was lessened, and visible results have been realized. For example, Rongxian Winery in Sichuan used waste liquid distiller's grains to produce methane gas. In 1980, it produced 590,000 cubic meters of gas and generated 210,000 kilowatt-hours of electricity. Methane gas was used as fuel for automobiles which travelled 48,000 kilometers. Methane was also provided for cooking and boiling water, satisfying all the needs of the workers of the plant. The methane fertilizer left after producing methane gas was also used as field fertilizers.

As methane gas is popularized and utilized, scientific research in methane gas have continued to develop. Since 1970, small methane pits in our nation's farm villages developed from rectangular methane pits and wide, large and deep methane pits to the most common type at present--the small round methane pits. In particular, the application of arch-less arching technique in building the pits has been noted by foreign experts. During recent years, our nation's pit building technique of hydraulic methane pits has been popularized in several dozen countries and has been called "Chinese type methane pits". This type of pit is structurally simple, the cost is low, and it is very suitable for popularization and application in Third World nations. Our nation is studying to improve this type of pits further. For example, Hangzhou and other places have popularized the separate floating lid type methane pit which is beneficial to maintaining a sufficient time for preservation of the base material and stabilizing the pressure of the gas in the pit. Nanhui and Shanghai has used solar energy and surplus heat from power generation to increase the temperature in methane pits. This is an effective way. The Hongni plastic methane pit is being trial produced by many units. Coatings for methane pits are also being continuously improved.

Our nation's broad numbers of scientific and technical workers have conducted massive research and exploration in the technology of methane fermentation and have proposed a set of technical processes for fermentation, including treatment of raw materials, mixing and adding of materials, inoculating substances and daily management of methane pits. Massive research has also been carried out to study the yield of gas by various raw materials, the concentration of dry matter in the various added materials, the inoculating substances, the effect of temperature and pressure inside the pit upon the yield of gas, the method of treating the raw material and adding stimulants. Visible results have been achieved. These have established a foundation for further improvement in the technological level and improvement in the amount of output of gas.

In recent years, research in microorganisms for methane fermentation has been launched on a widespread basis. For example, the Biology Department of Beijing University has separated out methane sarcinae and has filled the blank in our nation's research in the production of methane bacteria.

Our nation's broad numbers of scientific and technical workers have also conducted massive research in the insecticidal and sterilization effect of methane fermentation, the fertility of manure used to produce methane and improvement of thermal conversion efficiency of methane, and they have realized visible results. Large area experiments showed that methane pit fertilizers produce visible results in increasing agricultural yields. This is especially obvious in fertilizing dryland crops. Generally, the scale of increase in yield is between 3 percent and 10 percent and some increases have reached over 20 percent.

Although good results have been obtained in the popularization and application of methane in our nation's farm villages, some problems still exist and they need to be studied and solved in the future.

VII. Comprehensive Solar Energy

Our nation has 800 million people who live and engage in production in the broad regions of farm villages outside cities. To explore a way to develop energy in farm villages, the scientific and technical workers of the Electromechanics Institute of the Chinese Academy of Sciences once proposed the concept of a "comprehensive solar energy entity". At present, a production team in the suburban area of Changping in Beijing has been selected as the site for developing the plan and the design. The data on the region's solar energy, bioenergy, wind energy and hydraulic energy have been gathered in an attempt to use the principles of systems engineering and mathematical treatment of linear planning to conduct systems analysis of the designed plan. The idea is to build a small "farm village energy station" near the residential village of this production team, i.e., the main body of an experimental station of a "comprehensive solar energy entity". This "farm village energy station" would provide heat, electricity, water and liquid and gaseous fuels to the farm village. Although the work is still under planning and is still a planned "software engineering" project, to realize it requires more efforts in building massive "hardware engineering projects". We must study and develop various energy providing equipment and related materials that are highly efficient, cheap and suitable. But this effort reflects the enthusiasm of our nation's broad numbers of scientific and technical workers in energy. Our nation's development and utilization of new energy sources are continually deepening and developing.

[Reported by the Editorial Department of this magazine, written by Li Mengming [2621 1322 6900]]

9296
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ALTERNATE ENERGY RESOURCES AND CONSERVATION

SHALLOW SOLAR POOLS MAY AUGMENT CONVENTIONAL ENERGY SOURCES

Chongqing XIN NENG YUAN [NEW ENERGY SOURCES] in Chinese, Vol 3 No 6, 5 Dec 81, pp 14-19

[Article by Ye Kewu [5509 0344 2976] of the Second Design Institute of the First Ministry of Machine Building: "Design of Shallow Solar Pools"]

[Excerpt] Situation in Our Nation and Abroad

The idea of a shallow solar pool was conceived at the beginning of this century. Separating salt from sea water is done by using shallow solar pools of sea water. Water is a superior medium that absorbs solar radiation. Under definite conditions, using shallow pools of water to absorb solar energy is more economical than any other type of heat collector. The thermal efficiency is not low. If we want to supply a massive amount of hot water, the shallow solar pool is the only solar heat gathering system that can compete economically with fossil fuel.

The principle of the shallow solar pool is very simple. It uses solar energy to heat water contained in thin plastic sheets. The top of the container is transparent while the bottom is black to absorb the energy from the sun. Using plastic containers prevents the water from evaporating. The plastic container is placed on the bed of the pool with a heat insulating layer. The pool is covered by a glass fiber reinforced plastic cover shaped as an arc. The dimensions of the shallow solar pool can vary from different localities and the dimensions are not limited. The pool can be made very large. In regions at 30° north latitude, a shallow solar pool with planar dimensions of 5 meters x 60 meters and a depth of 100 millimeters of water can heat 30 tons of water from 15°C to 60°C in summer under ideal conditions. The annual amount of heat gathered can reach a maximum of 3.4×10^9 joules/square meter.

The advantage of the shallow solar pool is that it is cheap to build. Installation is convenient. It can be built on ground and also [illegible] roof tops. Maintenance is minimal. The amount of energy required for manufacturing the pool is small. Ordinary metallic heat collectors require a large amount of high temperature energy in the manufacturing process. Ordinarily, it would take 10 years to retrieve the amount of heat thus consumed from the sun's energy. The materials used by the shallow solar pool are mostly plastics and the amount of energy consumed in their production can be recovered in just 2 years.

The main shortcoming of the shallow solar pool is that its efficiency during winter is low. This is because in winter, the sun's altitude angle is low. The total radiation reaching the water surface is visibly lower than the total radiation of the best angle of inclination, and the shallow solar pool can only be in a horizontal position, therefore the amount of heat collected is not very much, especially in regions at a higher latitude. When conditions are favorable, this shortcoming can be overcome by adding cylindrically sectioned reflecting plates. In regions of 40° north latitude, the installation of reflecting plates at an angle of inclination equivalent to the degree of latitude can gather 35 percent more heat than the total amount of heat collected by a pool at a 0° angle of inclination. During the 3 months of December to February in winter, the plates can increase the amount of heat gathered by 400 percent. But because the reflecting plates cast a shadow in the back, there must be a distance between two shallow solar pools, thus the area of land taken up increases, and the consumption of heat, the amount of electricity used for pumping water and the cost for capital construction also increase. Therefore, the use of reflecting plates is only beneficial when there is plenty of land. We can also imagine installing reflecting plates facing south on parapets of buildings facing north so that the amount of heat collected by the shallow solar pool can increase while the shadow of the reflecting plates falls outside the pool surface.

The Lawrence Livermore Laboratory in California, USA, has been engaging in the study of solar pools for many years and has accumulated a lot of experience. The technology is also further along. The laboratory has designed a shallow solar pool system which can provide all the hot water needed for daily living of 10,500 soldiers and 20 percent of the hot water used for washing clothes at a certain American military camp. The system has begun commercial production. The laboratory has also designed a hot water supply system consisting of 112 shallow solar pools of 3.5 meters x 61 meters for a uranium mine in the state of New Mexico in the United States. The system takes up 3 hectares of land and can provide 50 percent of the annual amount of thermal energy needed by that mine. Each year, the system conserves 2,100 tons of fuel oil. After feasibility studies, that design has proven to be competitive economically.

Israel is also exerting a lot of effort to study shallow solar pools and has already built a shallow solar pool of 3 meters x 50 meters for heating a greenhouse. At the same time, it has also developed a portable shallow solar pool water heater. A plastic box is contained inside a light weight and convenient heat insulating box. The lid of the box serves as a reflecting plate.

The Battelle Research Institute of the United States has made an economic comparison of the shallow solar pool and other heat collectors and fossil fuels.

The costs span a broad range because the regions are different. Since 1976, the price of energy has again increased on a large scale. In comparison, this should be even more favorable for the shallow solar pool.

Domestically, the Shanghai County Methane Gas Office has conducted studies on shallow solar pools since 1974. A shallow pool with a depth of 150 millimeters covered by two layers of glass has been built on top of the roof of a bathhouse. The pool does not have any plastic bags. This type of shallow pool can provide hot water twice a day during summer but it can only provide hot water for showers for less than half a year mainly because the bottom of the shallow pool does not have a heat insulating layer and the locker room does not have heating facilities. Domestic practice proves that in the Shanghai area where the annual number of hours of sunshine is only 2,000 hours, the shallow solar pool has a potential for development. By popularizing it, many areas in our nation should also be able to use it.

9296
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NATION'S FIRST COMMERCIAL METHANE VENTURE BEGAN IN 1929

Chongqing XIN NENG YUAN [NEW ENERGY SOURCES] in Chinese Vol 3 No 6, 5 Dec 81 p 8

[Article by the Editorial Department of this magazine: "Preliminary Examination of the History of Development of Methane Gas in China"]

[Text] According to the preliminary examination of the history of methane development in the 1930s by the Chinese Methane Gas History Examination Group of the Chengdu Methane Science Institute, Ministry of Agriculture, most facts prove that China's effort to popularize and utilize methane gas began in the 1930s. At the time, Mr. Luo Guorui [5012 0948 3843] of Taiwan Province learned the experience of producing methane gas from his predecessors and began overall studies of the techniques of building methane pits, production, collection and application of methane gas in Shantou City, Guangdong Province. After a dozen years or so of hard work, Mr. Luo summarized a complete experience of building pits, and wrote a book called "lectures on the practice of using stored natural gas in China" in 1935. This was our nation's first relatively systematic discussion of the technology of building pits, fermentation and comprehensive utilization of methane gas. It served importantly to develop methane gas in our nation in later years.

In the summer of 1929, Mr. Luo opened our nation's first methane gas popularization agency in Shantou. The agency was named "The China Natural Gas Light Company". This was our nation's first effort to popularize methane gas. In the summer of 1931, Mr. Luo moved the "China Natural Gas Light Company" from Shantou to the Penglai Domestic Products Market in Xiaoximen in Shanghai and changed the company's name to "China Guorui Gas Company." Later, branch offices were set up in the provinces. According to available data and statistics, at the time, the company had ten provincial branches throughout the nation and methane pits were built in 13 provinces (cities). Students were recruited from the provinces and trained in methane training classes to become technical personnel. After the students graduated, some were sent back to their home provinces (cities) build the "Guorui Natural Gas Branch Company in x x province" and were put in charge of demonstration, popularization and the business of providing methane gas within the provinces (cities).

In the autumn of 1942, the Shanghai Penglai Domestic Products Market sold only Chinese products and shunned Japanese products. The Japanese invaders hated this very much and burned down the domestic products market and the Zhong Hua Guo Rui Wa Si Zong Hang. Our nation's first methane popularization and engineering agency that had been doing business for 10 years was forced to close. The branch offices relying on the headquarters closed one after the other. Our nation's methane popularization work during the early period thus ceased. At present, the work of examining the history of methane during the 1930s is still continuing.

9296
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ALTERNATE ENERGY RESOURCES AND CONSERVATION

DWINDLING RESOURCES, ENVIRONMENTAL DETERIORATION SPURS ALTERNATE ENERGY DEVELOPMENT

Beijing GUANGMING RIBAO in Chinese 20 Nov 81 p 3

[Article by Zhang Qinghai [1728 1987 3189]: "Energy Resources in China's Rural Villages"]

[Text] For a long period, farmers had to find everything that could be burned and use it to cook and produce heat. They broke off tree branches, burned firewood, and caused great damage to the forests. Soil erosion intensified. At the beginning of liberation, the area of soil erosion in our nation was 1.16 million square kilometers. Now, this has increased to 1.50 million square kilometers. The area that has become sand increased from 1.6 billion mu to 1.9 billion mu. The amount of mud and sand flowing into the rivers each year has reached 5 billion tons, taking away more nitrogen, phosphorus and potassium fertilizers than the amount produced during the whole year in our nation. As a result, the fertility of the land has drastically dropped, the ecological balance has been destroyed, and these have greatly affected agricultural production and people's lives.

There are many ways to develop energy resources in farm villages. There are fuel forests, methane, small hydroelectric power stations, small coal pits, geothermal energy, solar energy, wind energy, tidal energy and extraction of liquid fuel from plants, etc. Which energy resource structure should be used for different areas in farm villages is a major problem worth studying. Through massive surveys and studies of consumption of energy in farm villages, our preliminary belief is that during a relatively long period in the future, the ordinary energy resources provided by the state to the farm villages (coal, oil, electricity) will not increase much. Because each locality's conditions of resources, geography, climate and living habits are different, the energy resource structures should not all be of the same model. Constructing energy resources in farm villages should suit measures to local circumstances. There should be many forms of energy to supplement each other. They should be comprehensively utilized, and actual results should be produced. For example, the 13 provinces, cities and regions of the south should build methane pits in a big way. The northwest arid region can actively popularize the solar cooker. Some localities that have favorable conditions should strive to build more small hydroelectric power stations and small coal pits. In a relatively long period in the future, most of our nation's farmers will still be burning firewood and coal directly as the main energy sources, therefore popularizing cookers that conserve firewood and coal is the simplest and the most practical method to conserve fuel. Scientific research in solar energy, geothermal energy, wind energy, tidal energy and extraction of liquid fuel from plants must be strengthened and efforts should be exerted to improve their function as auxiliary energy resources. Each locality can establish different types of energy resource structures by combining the future and the immediate situation, by clearly differentiating the urgent tasks and the less urgent tasks according to the situation of resources.

Forestation and planting grass. This is a strategic problem. It can create superior natural conditions for agricultural production so that the state will have timber to use and the farmers will have firewood to burn. They are the material foundations for the farmers to solve the problems of fuel and to become rich.

Forestation must be determined. It must have a goal. It must have a plan. It must have concrete measures and clear guidelines and policies. It must be grasped tightly for 10 years so that the nation's percentage of forest covering can be increased from 12 percent to 20 percent. Our nation now has 1.2 billion mu of land suitable for forestation. Within ten years, efforts should strive towards the goal of one mu of forest per person on the basis of the presently available forest land.

Emphasizing energy conservation work in farm villages. Directly burning stalks, firewood, coal in the stoves is an ancient method handed down by our ancestors. There will not be any major change within the short period of the future. Our nation's farm villages burn 400 million tons of stalks each year and the thermal efficiency is very low. How to conserve fuel and improve thermal efficiency are the key points of future work in our nation. If half of the whole nation's farming families uses stoves that conserve firewood and coal, each year, nearly 100 million tons of stalks can be saved. By returning these to the fields, it is possible to increase the production of food grains by 17 billion to 20 billion jin. Popularizing stoves that conserve firewood and coal is an energy conserving method which requires little investment, produces quick results, and which is the most practical and the most convenient, and the method most easily accepted by the farmers.

Developing methane, small hydroelectric power stations and solar stoves in a big way. Localities that have favorable conditions should develop these three types of energy resources by suiting measures to local circumstances as long as finances and materials allow, especially methane. This is an important way to solve the problem of energy resources in our nation's farm villages. Others, such as geothermal energy, wird energy, tidal energy, extraction of liquid fuel from plants, etc, are still being studied and they are unsuitable for massive popularization.

9296
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ALTERNATE ENERGY RESOURCES AND CONSERVATION

MORE RESEARCH ON WAVE POWER TO PRODUCE ELECTRICITY URGED

Chongqing XIN NENG YUAN [NEW ENERGY SOURCES] in Chinese Vol 4 No 1, 5 Jan 82 p 42

[Article by Pan Dahong [3382 1129 7703] of the Dalian Port Scientific Research Institute: "Several Views on Generating Electricity From Waves"]

[Text] China's research in using waves to generate electricity is still in its infancy. Compared to advanced world levels, we lag far behind in level and scale. But from the long-range viewpoint, especially when considering the needs of building our nation's four modernizations and the natural conditions of having a wide expanse of seas and territory, the development of research in using waves to generate electricity should be given sufficient emphasis.

We must point out here that even though foreign nations possess several dozen patents on equipment to generate electricity from waves, few have been used in a practical way. Efforts to make them practical have been limited by the following conditions:

1) Because equipment to generate electricity from waves must be placed in sea water, consideration must be given to corrosion resistance.

2) Because waves and wind do not follow a fixed pattern, the equipment to generate electricity from waves must be able to withstand strong buffeting by wind and waves, and including the casing, the equipment must have sufficient mechanical strength.

3) Although the energy stored in waves is large, their speed of motion is slow. Their pressure is low and the energy density is small. To obtain a sufficiently large amount of energy, the electricity generating equipment must often be made very large.

4) Construction in water is still technically difficult at present and initial investment is large.

5) Combining the above factors, we see that as a result, the cost is often several times and several dozen times higher than ordinary energy sources.

The equipment installed on buoys for generating electricity from waves can be practical mainly because:

1) The buoy and the casing itself are placed in the sea, "the sea is the home", therefore the problem of extra cost to increase the anti-corrosive ability and to improve mechanical strength does not exist.

2) The buoy does not require a high output power from the electricity generating equipment. A navigation lamp of only 15 watts of power generally can be operated with an output power of 7 to 8 watts (including power loss of free discharge by the compensatory batteries). The key is to enable the equipment to generate output even when the waves are small to maintain "a steady flow of a small amount" of recharging current. This demand which is not high is not impossible to achieve on the buoy's own body weight and size.

Take Japan's Masuda Buoy as an example. Its largest power is 60 watts, but its record of generating electricity in Hakata Bay shows that the annual average daily output of electricity is 15 amperes hour/day. The average current is only 0.6 ampere and its voltage is 12 volts, thus its average power is only 7.2 watts and at most not surpassing 10 watts.

According to published information, the diameter of the tail pipe of the Masuda Buoy is 700 millimeters. The structure is a four-valve air pressure device. Because the directional valve sometimes malfunctions and because of gas leaks, its operation is not reliable enough, therefore Britain and the United States have placed a lot of emphasis on the valve-less structure. For example, the (Wells) turbine developed in Britain has blades of geometric shape with symmetric chords on two opposite sides to assure that when air enters and exits the turbine, it will drive the generator in the same direction of rotation. The United States uses turbine blades similar to those on the compressor of a gas turbine and also makes sure that when air enters and exits the turbine, the generator will rotate in one direction.

According to the preliminary experiment conducted by the author, with the valve-less structure that utilizes the symmetric wing air compressor, it is possible to obtain 6 to 7 watts of average output power. This type of buoyant equipment for generation of electricity from waves can be greatly simplified in structure.

The cost of this equipment is very high. But for those scattered and isolated islands which do not have electric power and need electricity, and considering the necessity, safety and the reduction of maintenance and cost, this type of power supply is still worth it compared to other methods of power supply.

In summary, from the long-range viewpoint, research in the generation of electricity from waves has major significance. Whether generation of electricity from waves can be truly practical depends on an overall consideration of its investment cost and economic results. Therefore, following positive and prudent guidelines to develop research in the utilization of this new energy source is necessary.

9296
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ALTERNATE ENERGY RESOURCES AND CONSERVATION

WIND-POWERED WATERWHEELS SAVE ENERGY

Fuzhou FUJIAN RIBAO in Chinese 4 Nov 81 p 1

[Article by Lin Yunxi [2651 0061 3356] of the Putian Prefecture Communications Station: "Putian Prefecture Salt-works Utilizes Wind-powered Waterwheels, Conserves Lot of Energy"]

[Text] The Putian Prefecture Salt-works uses the resources of coastal winds to actively popularize the use of wind-driven waterwheels to gather sea water to produce salt, greatly conserving energy consumption. Now, the whole saltworks has more than 350 wind-driven waterwheels distributed over the saltworks like white sails. The scene is magnificent.

The Putian Prefecture Salt-works is one of our province's largest saltworks Here, average force of the wind eleven months out of the year is over 3 on the Beaufort scale. Each month there are 21 days with winds between 3 and 5 on the scale. The distance of carrying water to the saltworks is only 0.7 meters to 1.5 meters. At the beginning of liberation, water was carried to the saltworks entirely by manually operated waterwheels and bails. Labor was intensive and efficiency was low. In 1958, it began to popularize the use of wind-driven waterwheels to carry water and to replace manpower. During the past 2 years, the saltworks' leadership paid attention to grasping the use of wind-driven waterwheels. Now, the saltwork's 108 work teams all use wind-driven waterwheels.

After the saltworks popularized the use of wind-driven waterwheels, visible economic gains were realized. According to calculations, the amount of salt water carried by one wind-driven waterwheel can cover 300 to 400 ares of the saltworks. The works can save 200 tons of diesel fuel for the state and 100,000 yuan in cost a year. The workers said: "Wind-driven waterwheels are structurally simple. The building cost is low. Installation, use and management are convenient. They do not require people to pedal. They do not require animals to power them. They do not burn fuel. They do not consume electricity. They are indeed good water-lifting tools."

The wind-driven waterwheel at the Putian Prefecture Salt-works.

9296
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ALTERNATE ENERGY RESOURCES AND CONSERVATION

PLANTING OF FORESTS TO PROVIDE ENERGY RESOURCES URGED

Beijing GUANGMING RIBAO in Chinese 25 Dec 81 p 3

[Article by Hou Yuanzhao [0186 0337 0340]: "Forest Energy Resources"]

[Text] Since antiquity, people have been felling trees for firewood to survive. Actually, forest energy resources have two meanings: One refers to energy resource forests, i.e., forests for producing energy resources. There are natural forests and also manmade forests. The second refers to the various kinds of residual substances, logs of small diameter, waste timber, etc, produced during the cultivation and felling of forests and processing of timber.

Unlimited Potential

In contrast to mineral energy resources, forest energy resources are regenerative. According to research abroad, the annual amount of growth of biological matter of natural tropical forests per hectare is equivalent to 0.9 to 2 tons of petroleum, and tropical manmade forests can produce an equivalent of 10 tons of petroleum per hectare. If such forests are managed well, the forests in Kalimantan alone can provide an amount of energy equivalent to that of the current amount of petroleum produced in Indonesia. The annual amount of growth of forests in major Southeast Asian nations is equivalent to 4.3 times the annual amount of energy consumed by Japan. Now, developed nations are experimenting with artificially dwarfed trees with a short felling cycle. The amount of biological substance produced by the artificially dwarfed forests of poplar under experiment in France reaches 40 tons of dry substances per hectare per year. The poplar forests under experiment in the United States can produce an equivalent of 430 barrels of petroleum of energy per hectare per year.

Such calculations show that the absolute amount of forest energy resources of a nation or a region is huge. For example, West Germany has utilized remnants from felling to solve half of the energy needs of the whole nation's civilian and small industry users. The amount of bark produced each year in the Soviet Union is equivalent to 13.6 million tons of standard fuel. Canada uses available waste timber and waste materials to produce 41.6 billion liters of methanol. The large potential of forest energy resources can thus be seen.

Some people have estimated that the amount of solar energy solidified by photosynthesis each year throughout the globe is equivalent to 10 times the amount of energy consumed by the world each year. On the surface of a continent of 360,000 square kilometers, if the solar energy conversion rate is 1 percent, theoretically speaking, the amount of biological substance produced can solve the energy needs of the whole world. Now, the reserve of biological substances around the world is 1841 x 10^9 tons (of dry substances), among them, biological substances of forests amount to 1650 x 10^9 tons, constituting 89.6 percent.

Hard To Replace

Viewing the development of energy in major nations, it seems that it has always gone from the energy resources of biological matter to petroleum energy resources of biological matter to petroleum energy resources and then to nuclear energy. But most nations now and in the future will not be able to and should not follow this path any longer. The petroleum that was formed several tens of millions of years ago has almost been exhausted by several scores of nations within the short period of 30 to 40 years. Although nuclear energy has a future for development, the resources for nuclear fission are also limited, and the practical application of nuclear fusion technology is still far away. It is suitable for developing nations to develop energy resources that are low cost, scattered and that require only suitable technology to produce benefits. We should base ourselves on developing the potential of every locality and composite energy resources by suiting measures to local circumstances. Farm villages generally are only suitable for developing such regenerative energy resources as forest resources, methane, small hydroelectric power, wind energy and solar energy. Now, farming areas, forest regions and timber industries of many developed nations are also exerting efforts to change and turn toward this direction.

Multiple Benefits

Forest energy resources produce many benefits, including productive benefits, ecological benefits and social benefits. These three benefits can also be generalized into two types, direct benefits and indirect benefits. In the United States, some people have studied the ratio of the value of direct benefits of forests (the production of timber) and the indirect benefits and found it to be one to nine, i.e., the value of indirect benefits is eight times larger than the value of direct benefits. Since fuel forests and various similar forms of energy resources are forests, they of course possess multiple benefits. Facts show that the value of indirect benefits of fuel forests far exceeds their own value when used as an energy resource.

In farm villages, the development of fuel forests can be combined with the development of agriculture, livestock production, bee keeping and sericulture, flue-cured tobacco production, brick manufacturing, pottery manufacturing and tea production.

Forest energy resources can be continually utilized and are inexhaustible. Forest resources are widely and evenly distributed. They are especially suited for developing nations and especially for the needs of farm village areas. Wood fuel does not contain sulphur. The residues from combustion are ideal fertilizers. Developing forest energy resources benefits renewal of the forests, improves the level of managing forests, and promotes the modernization of felling and shipping timber. Developing forest energy resources is low cost and can be realized by presently available manpower and materials. It does not need very high technology. The timber industry can utilize its own residual substances to realize self-sufficiency or partial self-sufficiency in energy resources, and this is beneficial to reducing production costs.

In general, after developing forest energy resources by utilizing barren hills and barren mountains, edges of fields, sides of houses and graveyards to plant trees and for forestation, the trees can be felled and utilized in 2 or 3 years. There is no other kind of energy resource in the world that can be developed and utilized as conveniently as forest energy resources and with such a broad mass character.

Develop Forest Resources as Quickly as Possible

At present, because of the lack of firewood in farm villages, residents have to fell forest resources of various kinds of nonfuel forests, or rake grass roots, tree bark or use stalks of crops and cattle dung as fuel for burning. This method of seeking and gathering energy resources everywhere will necessarily and seriously destroy surface vegetation, destroy the ecological balance, cause soil erosion, reduce soil fertility, and thus destroy agricultural productivity. According to estimates, the production of 20 million tons of grain is lost each year throughout the world in this way.

Among the 170 million farm families in our nation, over 70 million families now have a serious lack of firewood. According to surveys, each person in our nation's farm villages needs an average of 657 kilograms of fuel each year, but actually at present, each person has only 146 kilograms a year, only one-fifth the need. This also shows that of the 800 million farmers in our nation, only the energy needs of 160 million people can be satisfied. In the future, as production develops, as the population increases and as the life of the people improves, the amount of consumption of energy in farm villages will be larger, and the conflict between supply and demand will become more outstanding.

Based on this situation, we must urgently establish plans for the development of forest energy resources, plant fuel forests as important forests, include these plans in national energy resource plans, and at the same time, actively develop research and popularization in this respect to better satisfy the needs in building the four modernizations and to create benefits for the 800 million farmers.

9296
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ALTERNATE ENERGY RESOURCES AND CONSERVATION

FUJIAN FOCUSES ON BIOGAS DEVELOPMENT CONSERVATION

Fuzhou FUJIAN RIBAO in Chinese 21 Oct 81 p 1

[Article by reporter Ou-yang Ying [2962-2799 5391]: "Provincial Agricultural Committee Holds Working Conference on Biogas and Efficient Wood Stoves"]

[Text] To solve Fujian's energy problem in rural villages, the Provincial Agricultural Committee recently held a working conference in Fuzhou on building methane and on producing firewood saving stoves. The meeting decided that the main emphasis this winter and next spring will be on repairing and improving those methane pits in poor condition and on developing one group and using that group of pits well on this basis. At the same time, measures must be suited to local circumstances to popularize firewood conserving stoves and do the work of energy conservation in farm villages well.

The meeting relayed the spirit of the national working conference on building methane and producing firewood conserving stoves, summarized and exchanged the experience in building methane and producing firewood conserving stoves. The meeting believed that to solve the energy problem in farm villages, the principles of suiting measure to local circumstances, using many ways to conserve energy and supplementing each other's efforts, paying attention to practical results proposed by the Central Committee must be thoroughly implemented. In the past, many pits in poor condition and wasted pits were built in our province's efforts to popularize methane. They have ruined the reputation of methane. During the past two years, each locality has paid more attention to the quality of the methane pits and basically realized the goal of building one and using one. The percentage of successful pits is above 90 percent. The experience of advanced localities shows that developing methane not only can solve a large portion of the problem of fuel for farmers, it can also stimulate ecological balance, protect forests, change environmental sanitation, increase the efficiency of fertilizers, improve land fertility, and promote the development of livestock production. There are many benefits. The direction of developing methane is correct. It should be included as an important task in agricultural modernization and it should be carried out for a long period. Each locality must strengthen leadership, actively popularize methane, suit measures to local circumstances, pay attention to practical results, develop methane expansively, and progress steadily to build a firm foundation. The meeting decided that the main task this winter and next is to repair old pits, to repair and use well those pits that were built by simple methods and indigenous methods and that are in poor condition but still worth repairing so that the reputation of methane can be rehabilitated. On this basis, another group of methane pits should be developed in a key way and the many forms of methane management and the responsibility system must be established. Future methane development should be towards specialization and commercialization.

The meeting believed that while developing methane energy resources in farm villages well, each locality must also popularize each conservation work well. During recent years, the counties of Fuqing, Huian and Longhai have already created many types of firewood conserving stoves with high thermal efficiency. Each locality must survey and study the situation well and select some different types of suitable stoves according to the situation of resources of the locality and habits of the masses, let the masses select the stoves voluntarily, popularize the stoves from individual localities to the entire area and to develop such stoves steadily.

The meeting also discussed long-range plans for building methane and firewood conserving stoves.

9296
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ALTERNATE ENERGY RESOURCES AND CONSERVATION

USES OF BIOENERGY, BIOGAS IN YUNNAN EXPLORED

Kunming YUNNAN NONGYE KEJI [YUNNAN AGRICULTURAL SCIENCE AND TECHNOLOGY] in Chinese No 6, 25 Nov 81 pp 36-37

[Article by Jiang Yunhua [3068 5686 5478] of the Provincial Microbiology Research Institute: "Bioenergy and the Question of Developing Methane"]

[Text] What we call "bioenergy" generally refers to the energy obtained from the sun by green plants and living organisms. This is an indirect utilization of solar energy. Therefore, bioenergy has been included as part of solar energy for development in our nation and abroad.

It has long been known that solar energy has been the richest and the cheapest energy on earth. It is only because up to now, many difficulties in technology and economic investment still exist in the direct utilization of solar energy and therefore it cannot be carried out on a large scale. Green plants have an ingenious way of gathering and a system of storing solar energy. This is what is commonly called "photosynthesis." According to measurements, plants can convert from 0.5 percent to 6 percent of the total amount of energy radiated by the sun upon the earth into bioenergy in their bodies through photosynthesis. The theoretical figure is 12.5 percent. For example: planting one grain of paddy rice can produce a harvest of a handful of rice grains; sowing one seed can produce a large tree. These are all examples of plants storing solar energy for us.

Originally, in Earth's history, green plants began to utilize solar energy after they emerged. Objectively viewed, utilization of mineral energy such as natural gas, petroleum and coal which are being used on a large scale in the national economy is also the utilization of ancient bioenergy stored in the earth. Some people call this energy "fossil energy". But the reserves of this energy are finite. Viewing the long history of man's utilization of energy, mainly bioenergy has been used.

Does this mean that man learned to utilize bioenergy a long time ago? Is there nothing more scientists can do in this regard? Exactly the opposite. The science of bioenergy is one of the newest energy sciences. It has just begun to form. To truly utilize solar energy rationally, biological sciences still have a lot of work to do. For example, selective breeding of plants with highly efficient photosynthesis is one of the important tasks with a bright future.

There are many ways to develop and utilize bioenergy.

The first is the ancient way of direct burning. This is the most widely used, the simplest, and the most wasteful method at present. Its thermal energy conversion rate in our nation is 10 percent, and its loss is 90 percent. Some people have estimated that the amount of nitrogen fertilizers lost in this type of direct burning throughout the nation is equivalent to one-third the total production of chemical fertilizers in our nation in 1978. This, of course, is shocking, yet this method is still needed in some places, for example, a farm family in the mountain areas can solve the problem of a shortage of firewood by planting two mu of fuel forests.

The second method is to extract high-grade fuels similar to petroleum from certain plants by physical and chemical methods. American biologist Professor Kevin et al is studying this. They used Euphorbia lathyris belonging to Euphorbiaceae, Euphorbia tirucalli, Euphorbia triangularis trees. These "petroleum plants" also exist in our nation. The characteristic of such trees is a milky emulsion is present in their stems. The method of harvesting and processing share certain similarities with those frequently seen for tapping rubber. According to reports, the cost of this kind of fuel that is similar to petroleum may be competitive with the market price of petroleum.

The third method is to convert organic matter originating from plants into high-grade fuel through microorganic fermentation. This can be divided into two aspects:

1. Using methods of fermentation to convert organic matter into alcohol (ethanol) and methyl alcohol. The raw materials are wild plants and starch, wood scrap and waste fluid from paper manufacturing which are unsuitable to both man and animals. Brazil is the most active nation to use alcohol as a substitute for petroleum in the world today. Brazil's "alcohol plan" also proposes that in the not-too-distant future, alcohol will be used to substitute petroleum completely throughout the nation. In 1979, they produced over 900 million gallons of alcohol. They used 1 ton of starch to produce 600 to 650 kg of alcohol. The utilization rate was 90 percent. Distiller's lees are fermented to produce methane to provide one-third the energy needed to extract and distill alcohol. This process of energy utilization can be said to be relatively scientific.

2. Using plant raw materials to produce methane: This has already produced visible economic results in all localities in our province. At present, the whole province has about 16,000 methane pits. Those that are normally used constitute about two thirds. A $10M^3$ methane pit of the new type requires an investment of about 100 yuan to build and complete. If management is appropriate, it can completely solve the fuel needs for daily living by a farm family of five members. Converting stalks and stems of crops and methane energy plants into methane and burning the gas have a thermal energy conversion rate reaching 94 percent (a loss of only 6 percent). Methane is also a superior fuel for internal combustion engines. If diesel engines change to burning methane, over 90 percent of diesel fuel can be replaced by methane. The greatest advantage of producing methane using plant raw materials is that

a large quantity of superior organic fertilizers can be obtained. The three major elements of nitrogen, phosphorus and potassium in the raw materials all basically remain intact.

Some people have estimated that if all the wastes produced in the food cycle in the world (including man and domesticated animals) were converted to CH_4 by methane fermentation, the energy thus obtained is 3.39×10^{15} kilocalories, equivalent to one-third the world's annual consumption of fossil fuels.

The fourth way of developing bioenergy is to use "artificially simulated photosynthesis" to utilize solar energy. This is a more widespread way to produce energy and is worth studying.

The following is an estimate of the potential of bioenergy and methane in our province.

According to surveys, our province has about 500 million mu of land which can provide growth of green plants. If this land is truly utilized scientifically on an overall basis according to modern methods, then, according to a rough calculation by experts in photosynthesis, each mu can provide one ton of dry plant matter each year. Thus, each year, 500 million mu of land can provide us with 500 million tons of dry plant matter. From the energy viewpoint, many of the chemical elements in dry plant matter are similar to those in coal, and the "thermal value" of dry plant matter is at least equivalent to that of raw coal. If we use 50 percent of 500 million tons directly as energy (i.e., minus 50 percent food grains, timber and such regular dry plant matter), each year, this amount can provide 250 million tons of dry plant matter. This means, it is possible for the arable land throughout Yunnan to produce an equivalent of 250 million tons of raw coal each year. I feel that this potential should not be belittled because it is scattered. It should be very sizable. In other words, the characteristic of this type of energy being scattered is exactly adapted to the characteristic of the population which is scattered. Thus, a large amount of energy transportation costs can be conserved. For example, at present, the "Frontier Technology Research Company" and the "Green Mountain Power Company" of the United States are studying "energy trees" such as hybrid "white poplar" which has a high photosynthetic efficiency for use as fuel for thermal power plants and to replace coal.

The following discusses the potential in developing methane in our province. Everyone already knows that because the temperature difference between the seasons in our province is small, it is suitable for popularization of methane fermentation on an overall basis. The phenomenon of "having inexhaustible methane in summer and a shortage of methane in winter" in other provinces does not exist in our province. If our methane pits can be developed on an overall basis, and if the science and technology of our development of methane catches up with the modern levels, then what must be estimated is the amount of raw materials available for methane fermentation.

This data, calculated according to the presently available area of arable land of 40 million mu in our province and according to an estimated production of

0.6 tons of raw materials for methane fermentation per mu per year, each mu can provide about 300 m^3 of methane gas each year (or equivalent to 300 kilograms of coal). This means, from the presently available arable land we can obtain an amount of methane gas equivalent to 12,000,000 tons of coal each year. Therefore, it is possible that the development of methane could serve an important auxiliary function as fuel in certain aspects, such as solving the problem of fuel for living in farm villages. Yuanjiang County conducted a general survey of three communes in the Reba area not long ago and believed that if the methane resources of these three communes could all be fully utilized, then, besides satisfying the demands for thermal energy to produce feed and living needs of all the residents of the three communes, there will still be about 40 percent of methane fuel left over.

Of course, the 250 million tons of dry plant matter and methane equivalent to 12,000,000 tons of coal are both theoretically derived figures. To achieve these theoretical figures, a lot of effort must be exerted by every sector.

9296
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SUGARCANE TOUTED AS EXCELLENT BIOENERGY RESOURCE

Fuzhou KEXUE YU WENHUA [SCIENCE AND CULTURE] No 2, 25 Mar 81 p 12

[Article by Xu Kehua [1776 0344 5478] and Zhang Xinzheng [1728 2450 1073]: Sugarcane: Raw Material for Energy and Light Chemical Industry]

[Excerpt] Using sugarcane to make sugar for food is one of its major values. New developments in the sugarcane sugar industry at home and abroad have shown that sugarcane has an even broader future in the non-food area.

Excellent Bioenergy

At present, it is recognized throughout the world that the most reliable and cheapest energy is bioenergy. This is because fossil energy sources (such as petroleum and coal) must accumulate for millions of years before they are available, the amounts are limited, and distribution is uneven. However, bioenergy (such as sugarcane) can be continuously produced by mankind and obtained in a short period of time. At the same time, this kind of energy can be developed continuously, its distribution is even, and its cost is much lower than that of developing fossil energy sources.

A ton of sugarcane has an average of 160 kg of fermentable solids (which can produce 15.6 gallons of alcohol) and 121 kg of combustible solids. Sugarcane's energy is obtained from solar energy via photosynthesis, and in addition its utilization rate of solar energy is higher than that of all other crops. Sugarcane can be harvested after a year of growth, and its theoretical yield approaches 40 tons/mu. At present, the highest yield attained at home or abroad is 50-60 percent of the theoretical yield, and the average yield/mu for Fujian in 1979 was 4.8 tons. Therefore sugarcane is already attracting attention as a renewable, cheap, clean bioenergy resource. At present, the country with the highest output of sugarcane is Brazil, where 41 percent of the total sugarcane yield goes to making alcohol, and whose president has ordered that government automobiles must gradually switch to alcohol as fuel, by way of dealing with the gasoline shortage. Many other countries of Latin America and India are also developing sugarcane as a bioenergy source and studying trial applications of "gasohol."

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ALTERNATE ENERGY RESOURCES AND CONSERVATION

FUJIAN PINS HOPES ON RENEWABLE ENERGY SOURCES TO AUGMENT COAL, HYDROPOWER

Fuzhou FUJIAN RIBAO in Chinese 29 Oct 81 p 3

[Article by Ye Qing [5509 3237]: "Exert Efforts To Develop and Utilize Our Province's New Energy Sources"]

[Text] As industrial and agricultural production develop, the need for energy sources will increase year by year. Before liberation and just after the founding of the nation, Fujian's energy mainly relied on burning timber. Large amounts of logs were thrown into boilers and burned to cinders, seriously destroying forest resources. For example, Longyan Prefecture originally had a forest reserve of 57,300,000 cubic meters. By 1972, when the general statistical surveys of forest resources were conducted, this had dropped to 41,130,000 cubic meters, a reduction of over 10,000,000 cubic meters. This is truly shocking.

Fujian's coal industry has undergone a fair amount of development. Many new coal fields that could provide coal pits have been found. Many new coal pits began production and the yield of coal increased year by year. In 1952, the annual production of coal in the province was only 2,000 tons. By 1980, the yield of raw coal throughout the province had reached 4,620,000 tons (the yield in 1979 was 4,790,000 tons, the highest level in history). The yield of raw coal has increased over 2,000 times, greatly improving our province's self sufficiency in coal. But Fujian is still a province deficient in coal. The coal resources in Fujian Province are in the form of coal sediments in small basins. The geological structure is very complex, and this has created definite difficulties in development and utilization. Now, there are fewer and fewer reserve bases which can continue to provide coal pits. Up to the end of 1977, 60.5 percent of our province's known reserves of coal resources had been developed and utilized (including production and capital construction). At the same time, the type of coal is not varied. The coal is mainly anthracite for civilian use and for use by the chemical industry. There is a shortage of coal for producing power and coking. The districution of coal resources is also uneven, and transferring and shipping of coal are not convenient. To develop our province's economy and to establish a complete and independent industrial network, besides placing coal at the foremost position, developing new energy sources has become a task that cannot be delayed.

Which new energy resources can our province develop?

Hydraulic energy. Fujian's topography is complex. There are many rivers within its boundaries. They contain very rich hydraulic resources. According to resource surveys, the reserve of hydraulic power in Fujian is 104.5 million kilowatts. Of this, 70.5 million kilowatts can be developed and utilized, equivalent to more than 40 times the total output of electricity of the whole province at present. This is wealth that can be utilized! Before liberation, Fujian's electric power industry was pitiful. After liberation, a large number of large thermal power plants were built and at the same time, large hydroelectric power stations of Gutianxi and Ansha were built. Construction of large hydroelectric power stations such as Jinxi are being stepped up. In addition, there are many medium sized hydroelectric power stations and small hydroelectric power stations which have bloomed like flowers. Hydroelectric power stations already provide two-thirds of the total output of electricity of the whole province, serving an important role in our province's economic construction but up to the present time, the utilization of hydraulic resources has not reached one-sixtieth of the exploitable reserves. There is still a lot of potential for the development and utilization of hydraulic resources in Fujian.

Also, for example, in thermal energy, Fujian is especially rich in geothermal resources. According to surveys, over 170 locations with hot springs have been found throughout the province. Geothermal energy can be utilized to generate electricity. There are many good harbors and bays in the 3,300 kilometers of rugged coastline and the tides can be utilized to generate electricity.

The broad numbers of farm villages are popularizing the use of methane. It is clean and it increases the efficiency of fertilizers. It also provides a safe and cheap source of energy for daily living and production. Popularizing methane is indeed a feasible enterprise that can do a lot. There are also wind energy and solar energy. Fujian is situated in the subtropics. The hours of sunshine are long. Sunlight is sufficient. And Fujian has all the conditions for utilizing solar energy to benefit the people. At present, some localities have built solar cookers.

New and renewable energy resources are non-polluting and cheap. They have a huge reserve and they cannot be exhausted. We must lift up our spirit, develop and utilize the new energy sources in a big way to provide a strong motive force for economic construction to build Fujian into a richer and more beautiful place.

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NEI MONGGOL COMMENTARY ON ENERGY CONSERVATION

SK270916 Hohhot Nei Monggol Regional Service in Mandarin 1100 GMT 26 Mar 82

[Station Commentary: "Conscientiously Make a Success of Energy Conservation"]

[Excerpts] Since the Third Plenary Session of the CCP Central Committee, the national economy has rapidly developed under the guidance of the readjustment policy. More and more energy is needed. While we are vigorously exploring energy resources, we should attach more importance to conservation now and in the near future.

Except for a few localities, most places in our region have fairly sufficient coal supplies. This is a favorable condition for developing the national economy. However, many leading comrades of industrial and communications enterprises who are used to ample supplies have a very good sense of energy conservation. They even think that there is little need to conserve energy in our region. This is a major ideological obstacle to our energy conservation work. Disrespect for energy conservation is a reflection of disrespect for the whole situation.

Except for a few, industrial enterprises in our region consume more energy than the national standard in terms of per-unit consumption. Every year our region consumes about 5 million tons more standard coal than the national standard. They are worth about 290 million yuan. If we save 5 percent a year, we can save 14.5 million yuan. If we reduce our per-unit energy consumption 3 to 5 percent, costs of comparable products can be reduced by about 4 percent. Therefore, conserving energy per-unit consumption is an important measure to reduce costs and achieve better economic results.

According to a rough estimate, energy consumption of the 23 enterprises whose annual energy consumption are over 50,000 tons of standard coal amounts to about 70 percent of the total energy consumption of our region. They should earnestly pay attention to their great potential for energy conservation. Smelting of nonferrous metals and production of ferroalloy, pig iron and calcium carbide should be done in a planned way to avoid blind production, energy waste and overstock of products. Modification of equipment which consumes a great amount of energy is conducive to energy conservation. It is necessary to modify such equipment so that it consumes less energy.

CSO: 4013/41

BRIEFS

LIAONING ENERGY CONSERVATION--The Liaoning Provincial People's Government sponsored a commendation rally in Tieling Municipality 23-26 March to honor advanced units and individuals who had emerged in saving energy. The rally stressed that our province should achieve a production increase by curtailing energy consumption. Tan Liren, deputy governor of the province, addressed the rally. He noted: Our province saved 2.12 million tons of fuel coal in 1981. However, the energy utilization rate in our province is lower than the advanced standard at home and abroad. He called for new efforts to conduct training work in this regard and to intensify the management of energy resources. [Shenyang Liaoning Provincial Service in Mandarin 1100 GMT 28 Mar 82 SK]

NEI MONGGOL ENERGY CONSERVATION--Industrial and communications enterprises in the Nei Monggol Autonomous Region conserved 372,800 tons of coal, 77 million kwh of electricity, 17,800 tons of refined oil and 30,900 tons of coke in 1981. Before 1979, annual power consumption at Baotou aluminum plant was 430 million kwh, 20 percent of power consumption in Baotou Municipality. In 1979 the plant modified its power-consuming equipment. It saved 13 million kwh of electricity the same year. In 1980 the plant's power consumption in producing each ton of aluminum was the lowest among the eight large aluminum plants in the country. In 1981 its power consumption for each ton of aluminum declined to 14,657 kwh, an advanced world standard. [Hohhot Nei Monggol Regional Service in Mandarin 1100 GMT 26 Mar 82 SK]

BIOGAS EXHIBITION--Changding, 20 Oct--The National Methane Exhibition jointly sponsored by the National Methane Office, the Agricultural Exhibition Hall and the Provincial Methane Office opened today at the sports arena in Changding County. The exhibition introduces basic knowledge about methane, techniques of building pits, scientific management, provides information and showed pictures of advanced units in the nation and the province which have popularized and used methane, and showed various types of stoves, lamps and manure collectors. On site demonstrations of using methane to light lamps and boil water and of conserving firewood and coal were held. During the period of the methane exhibition, a short-term training class in methane techniques also began today. Experienced methane technicians from Sichuan, Hebei and Jiangsu provinces are training over 50 methane technicians for the prefectures of Longyan, Sanming and Jianyang by lecturing and building methane pits at the same time. [Text] [Fuzhou FUJIAN RIBAO in Chinese 21 Oct 81 p 1] 9296

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May 10, 1982